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ABSTRACTS

of recent published material on
Soil and Water Conservation

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The articles in "ABSTRACTS of recent published material on Soil and Water Conservation" are abstracted by Charles B. Crook in the Soil and Water Conservation Division of the Agricultural Research Service.

The ABSTRACTS are issued at irregular intervals. Their purpose is to bring together a summary of current published information about soil and water conservation work. Reprints of abstracted articles are generally not available in the Division. Requests for reprints should be sent to authors or institutions--addresses are appended.

The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" of the Soil Conservation Service. Abstracted articles are not editorialized and the language of the author is used wherever possible. In foreign articles, the units of measure are converted to usual American units. Tables are included where they help to present the information. When an entire number of a publication is devoted to reviewing one subject then the entire publication is abstracted as one article giving title and authors of each paper included in the publication. Abbreviations of journals and addresses follow U.S.D.A. Misc. Pub. 765, July 1958.

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R. S. Dyal, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Md., 20705.

CONTENTS

	PAGE
WATERSHED ENGINEERING	
Watershed development	5
Hydrology	5
Geology	8
Engineering design	8
WATER MANAGEMENT	
Irrigation.....	8
Drainage.....	15
Storage and conveyance	18
BASIC SOIL SCIENCE	
Soil physics.....	19
Soil chemistry and mineralogy.....	28
Soil biology	41
Soil-plant-animal relationships.....	43
Soil classification.....	49
EROSION CONTROL	
Wind and water erosion	55
Terracing	56
Critical areas.....	57
SOIL MANAGEMENT	
Cropping practices	59
Crop residue management.....	60
Tillage	62
Fertility requirements for conservation farming.....	64
Salinity and alkali problems	74
Cover crops and green manure crops.....	78
Climatic influences.....	78
Surface soil removal.....	83
Mulching.....	84
PLANT MANAGEMENT	
Pasture and haylands	85
Rangelands.....	87
Plant materials.....	89
Woodlands.....	91
Management of coffee plantations	100
Fruit and nut crops.....	100
Field crops	103
Vegetable crops	105
ECONOMIC AND SOCIAL ASPECTS OF SOIL AND WATER CONSERVATION	
Costs and returns.....	110
Institutional, educational, and social factors affecting conservation farming.....	113

CONTENTS--Cont.

	PAGE
BIOLOGY	
Fish.....	120
Upland wildlife.....	126
Wetland wildlife.....	134
SUPPLEMENT	
Problems indirectly affecting the application of Soil and Water Conservation practices.....	139
Radioactive fallout.....	140

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WATERSHED ENGINEERING

Watershed Development

Harold, L. L. ESTIMATING FLOOD VOLUMES AND HYDROGRAPHS CORRESPONDING TO PEAK FLOWS OF GIVEN FREQUENCIES FOR SMALL AGRICULTURAL WATERSHEDS. J. Geophysical Res. 67: 4341-4346. 1962.

A method for obtaining estimates of flow volumes and flood hydrographs corresponding to flood peak frequency values for watersheds of 20 to 20,000 acres was presented. Flood flow volumes and hydrographs can be used for design purposes, as they are near the maximum that can be expected to occur with the flood peak of the chosen probability. The method was derived from watersheds at Coshocton, Ohio, and its evaluations may be expected to be reasonable for similar watersheds in that area. The method may also be applicable to other watershed data.

SWCRD, ARS, USDA, Coshocton, Ohio.

Hydrology

Riggs, H. C. ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION; UNITED STATES AND CANADA, 1955-58, U.S. Dept. Int., Geol. Survey Water Supply Paper 1546. 237 pp. \$1.00. 1962.

This bibliography was prepared in cooperation with the Subcommittees on Hydrology and Sedimentation of the Inter-Agency Committee on Water Resources.

A selected list of papers, articles, and books which were published in the period 1955 through 1958 in the United States and Canada was presented. Every effort was made to include all listings of significant technical value in the fields of hydrology and sedimentation. Articles in the fields of the many allied sciences are cited.

Annotations are brief and are intended only to indicate to the reader whether or not the article referred to might furnish information of the type sought. A few articles are not annotated, either because the article was not available or because the title adequately described the article.

Listings are arranged alphabetically by author, followed by a combined subject and geographic location or river-basin index. Each article is indexed by primary subject, and by geographic area if applicable. Some articles are also indexed by secondary subjects.

For sale by the Supt. Doc., U.S. Govt. Printing Off., Washington, D.C., 20402.

Dreibelbis, F. R. SOME ASPECTS OF WATERSHED HYDROLOGY AS DETERMINED FROM SOIL MOISTURE DATA. J. Geophysical Res. 67: 3425-3435. 1962.

The soil moisture distribution in 8-foot profiles on four watersheds indicated that the zone of major hydrologic activity lies in the upper 12 inches of soil and particularly in the 0- to 7-inch A horizon. The average seasonal moisture curves of 5, 6, and 7 locations on three watersheds were compared with those of their respective adjacent lysimeters. The variations of soil moisture distribution in each of the watershed replicates reflect soil profile characteristics and location of site on the watershed, thus emphasizing the factor of

soil heterogeneity in watershed hydrology. The total amount of water in 54- and 72-inch profiles in lysimeters differed from that in adjacent watersheds in three comparisons made for a 12-month period. This deviation was affected by soil type and moisture content. Water budget studies indicated that evapotranspiration values for an 8-month period ending December 1960 was between 28.02 and 30.90 inches on lysimeters and between 26.14 and 27.84 inches on their adjacent watersheds in 0- to 54-inch profiles. Slightly higher values were obtained in 72-inch profiles for the same period.

SWCRD, ARS, USDA, Coshocton, Ohio.

Court, A. MEASURES OF STREAMFLOW TIMING. J. Geophysical Res. 67: 4335-4339. 1962.

Half-flow dates, defined as the dates on which half of the year's total streamflow has passed, appear to be useful measures of streamflow 'timing.' For studying possible changes in streamflow regime caused by watershed management practices, especially vegetational manipulation aimed at increasing snowpack and delaying snowmelt, half-flow dates seem to be more suitable than the date of momentary maximum flow. They are more sensitive to change in regime than another criterion in general use, the percentage of flow occurring during one or more fixed months.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Matalas, N. C. STATISTICS OF A RUNOFF-PRECIPITATION RELATION. Geol. Survey Prof. Paper 434-D, 9 pp. 1962.

The results of an analysis of the influence of the water-retardation characteristics of a river basin on runoff distribution are presented. The runoff was assumed to be generated by a moving average of the effective precipitation, where the extent of the moving average is assumed to be equal to the carryover--a function of the water-retardation characteristics of the river basin.

The probability distribution of the runoff is a function of the extent of the carryover period. Even though the characteristics of the effective precipitation may be the same for all river basins, the probability distribution of the runoff is not the same, because water-retardation characteristics vary from one river basin to another.

Owing to the carryover period, runoff is nonrandomly distributed in time. The serial correlation coefficients that are used to measure the nonrandomness of runoff are functions of the coefficients of the moving-average model, if it is assumed that effective precipitation is randomly distributed in time.

The moving-average model and the theoretical results derived from it are supported by experimental results obtained by analyzing several long-term runoff records.

For Sale by Supt. Doc., U.S. Govt. Printing Off., Washington, D.C., 20402.

Kohler, M. A., and Richards, M. M. MULTICAPACITY BASIN ACCOUNTING FOR PREDICTING RUNOFF FROM STORM PRECIPITATION. J. Geophysical Res. 67: 5187-5197. 1962.

As a result of variations in soil and surface characteristics, vegetative cover, etc., the moisture capacity is highly variable from point to point over a river basin. The daily

accounting procedure described was based on the premise that the mean moisture deficiency for the basin can best be derived by weighing the simultaneous values obtained by maintaining several sets of accounting computations with different assumed capacities. The weights applicable to the several deficiencies are determined through multiple correlation with observed precipitation and streamflow. In maintaining the accounting for a particular capacity, evapotranspiration is assumed to be at the potential rate as long as the deficiency is less than the selected capacity and the portion of precipitation used to recharge the basin is estimated as a function of existing moisture deficiency. Daily potential evapotranspiration is computed from observations of air temperature, dewpoint, wind, and solar radiation or percentage of sunshine. The reliability with which the runoff, storm by storm, can be predicted from the derived moisture deficiencies indicates that both the weighted deficiency and the evapotranspiration are reasonable. The basic purpose of the paper is to describe a method of basin accounting rather than the use of such accounting to correlate rainfall to runoff.

U.S. Weather Bur., Washington, D.C.

Packer, P. E. ELEVATION, ASPECT, AND COVER EFFECTS ON MAXIMUM SNOWPACK WATER CONTENT IN A WESTERN WHITE PINE FOREST. *Forest Sci.* 8: 225-235. 1962.

Maximum snowpack water content in a small white pine-forested watershed in northern Idaho during four winters was related to elevation, aspect, and density of forest canopy. Distribution of maximum snow water content can be accurately described by an equation containing the first three power functions of elevation, the first three power functions of aspect, a linear function of forest canopy density, a linear interaction between magnitude of snowfall from year to year and elevation, and a linear interaction between aspect and elevation. These nine variables accounted for 91.6 percent of the variance in snow water content with a standard error of estimate of 2.8 inches.

Throughout its range from 2,700 to 5,500 feet, elevation accounted for an increase of 30.1 inches of water content in the average snowfall year. The effects of aspect varied with elevation. The aspects on which minimum and maximum water contents occurred were, respectively, 165 and 11 degrees, measured as azimuths from the north. At 2,700 feet, a change of aspect from 165 to 11 degrees resulted in an increase in snow water content of 4.3 inches, but at 5,500 feet the same shift in aspect affected an 18.8 increase in snowpack water.

Snow water content was affected uniformly by changes in the forest canopy regardless of elevation, aspect, or magnitude of snowfall. It increased 4.2 inches with a change in canopy density from a completely closed canopy (100-percent density) to a completely open condition (zero canopy) such as would occur by clear cutting the timber. The forest effect on snowpack water content was related to known cumulative diameter and basal area characteristics of white pine stands. These relations showed that the largest increases in snow water content occurred with diameter and basal area reductions in the densest forest stands and became smaller with comparable diameter and basal area reductions in more open stands.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Geology

McGuinness, J. L., and Harrold, L. L. SEASONAL AND AREAL EFFECTS ON SMALL-WATERSHED STREAMFLOW. J. Geophysical Res. 67: 4327-4334. 1962.

The small-area streamflow regimen at Coshocton was found to be regulated primarily by the seasonal effect of evapotranspiration. Size of area as an index of geological conditions was a significant modifier of the streamflow pattern. An investigation of the seasonal and areal effects with duration and frequency of flow showed that the seasonal effect caused a sinuous relationship between flow volumes and durations of flow. Nomogram charts of the relationships for high and low flows were developed for obtaining flow estimates which may be modified by rainfall and other factors for application in the Allegheny Plateau region.

SWCRD, ARS, USDA, Coshocton, Ohio.

Engineering Design

Stanton, C. R., and McCarlie, R. A. STREAMBANK STABILIZATION IN MANITOBA. J. Soil and Water Conserv. 17: 169-171. 1962.

Streambank protection work initiated more than a decade ago on Edwards Creek in the Province of Manitoba, Canada, was designed to employ a minimum of mechanical methods and maximum vegetative control of bank erosion.

The six different methods used to control bank erosion were: Sloping; seeding and planting; lining with piles; laying netted rock rip-rap; dumping low rock toes; establishing rolled willow toes; and installing pile jetties. Protection measures were applied to 33 sections of the streambank.

Detailed conclusion of results from the six different methods were given.

Prairie Farm Rehabil. Adm., Canada Dept. Agr., Brandon, Manitoba, Canada.

Jones, B. L., and Unger, D. G. MEASURING EFFECTS OF CONSERVATION. J. Soil and Water Conserv. 17: 172-174. 1962.

A punched-card system developed for computer analysis of land use, land treatment, and hydrologic data in a cooperative State-Federal study of three small Pennsylvania watersheds was reported. The system makes it possible to tabulate and analyze data accurately and rapidly. Records are easily stored and made available for use.

Geol. Survey, U.S. Dept. Int., Harrisburg, Pa.

WATER MANAGEMENT

Irrigation

Doss, B. D., Bennett, O. L., and Ashley, D. A. EVAPOTRANSPIRATION BY IRRIGATED CORN. Agron. J. 54: 497-498. 1962.

The evapotranspiration rate by irrigated corn was determined on a Greenville fsl during the 1957-60 growing seasons. The average evapotranspiration rate by irrigated corn was

generally low in the spring while plants were small, with a gradual increase until a peak-use-rate period was reached during the first tassel to late dough stage, and then a gradual decrease until grain maturity. Average rates were from 0.07 to 0.23 inch per day with a range from 0.05 to 0.30 inch per day.

Moisture was first extracted at a shallow depth beneath the plant, and then at successively lower depths. The depth of extraction increased with plant development.

The ratio of evapotranspiration by corn to pan evaporation varied from 0.38 at emergence to 1.12 during early dough stage then declined to 0.95 at maturity.

SWCRD, ARS, USDA, Thorsby, Ala.

Keller, J., Willardson, L. S., and Woodward, G. O. "LET'S TAKE A CLOSER LOOK AT SPRINKLER IRRIGATION INTERVAL AND SYSTEM CAPACITY DESIGN FACTORS". Sprinkler Irrig. Assoc. Proc. pp. 56-66. 1962.

To take the fullest advantage of the better moisture controls offered by improvements in equipment and engineering, more precise concepts of interval and capacity are necessary.

In designing sprinkler irrigation systems, the following should be given consideration: (1) For deep-rooted crops 2 days may be added to the irrigation interval to allow for the transient water (draining water) storage. For shallowrooted crops 1 day or less may be all that is allowable. (2) The length of time of the lateral setting may be added to the irrigation interval. (3) System capacity design can be based on the average peak consumptive-use rate over a period of three times the irrigation interval. And (4) the usage of the 50 percent rule of convenience should undergo much refinement. A different percentage moisture level seems in order for each crop in question.

Utah State U., Logan, Utah.

Machmeier, R. E., and Allred, E. R. OPERATING PERFORMANCE OF A BOOM SPRINKLER--A FIELD STUDY. Trans. ASAE 5: 220-225. 1962.

With the boom sprinkler, it is desirable to apply the water as evenly and as economically as possible. One of the major factors affecting the uniformity of water distribution was wind speed. To minimize the variation in the speed of rotation under high wind conditions, one technique is to rotate the sprinkler at relatively high angular speeds. The sprinkler should be rotated at a speed of approximately one revolution per minute. While some decrease in wetted diameter can be expected, the fast boom speed appears to have a net operational benefit.

The nozzles along the boom arm should be set at an upward angle of elevation of at least 17 deg. with the horizontal. Although the angle of elevation is not a significant factor in low winds, it does increase the uniformity of water distribution in high winds.

With the sprinkler and nozzle arrangement under test, it was found that pressure did not have a significant effect on the uniformity of water distribution. A pressure of 45 p.s.i. performed as well as pressures of 55 or 65 p.s.i. Operating the sprinkler at the lower pressure resulted in considerable power saving.

With the large wetted diameter of the boom sprinkler, it was difficult to attain proper overlap of adjacent patterns without excessive watering or dry spots. A triangular or staggered spacing resulted in the best distribution uniformity over the field area.

The spacings used in this series of tests would not apply to sprinklers with different wetted diameters. The average wetted diameter did not seem to vary appreciably with the pressure and was found to be approximately 340 ft. A triangular setting of 300 ft. would be equal to the boom diameter of 200 ft. plus 70 percent of the difference between the wetted diameter and the boom diameter.

U. Minn. St. Paul, Minn.

Korven, H. C. BORDER DITCH AND BORDER DIKE IRRIGATION. Trans. ASAE 5: 192-196. 1962.

The "topographic method" for studying the uniformity of water application which considers the variability across the strip as well as along the strip was introduced. The results of a statistical analysis of the fundamental relationships in irrigation efficiency are presented.

The mean water-application efficiency from 24 observations of both border dike and border ditch irrigation was 70.5 ± 14.5 percent. The mean uniformity coefficient of water application from 30 observations was 70.9 ± 7.6 percent.

The uniformity of water application was depicted by plotting a "topographic" map of the soil moisture stored expressed in inches. This technique provides a more detailed analysis of the uniformity of water application across and along the strip than is the case with the advance-recession curve technique. An added advantage of this technique is that it is applicable for any method of irrigation.

Simple correlation analysis showed that at the 5 percent level:

1. Water-application efficiency and uniformity of water-application coefficients were related.
2. Water-application efficiency and uniformity of water application improved as the soil moisture content at time of irrigation decreased when irrigating by the border ditch method.
3. Head had no effect on water-application efficiency, but the uniformity of water application improved as the head increased for border ditch irrigation.
4. The rate of water application decreased as the soil moisture at time of irrigation increased for both border ditch and dike irrigation, but increased with an increase in head for the border ditch method of irrigation.
5. The net depth of water was not affected by soil moisture at time of irrigation.
6. The net depth of water applied increased as the head increased when irrigating by the border ditch method.

Expt. Farm, Res. Br., Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

Corey, G. L., and Fitzsimmons, D. W. INFILTRATION PATTERNS FROM IRRIGATION FURROWS. Idaho Agr. Expt. Sta. Res. B. 59, 16 pp. 1962.

The theory, apparatus, and procedures for studying unsaturated flow from irrigation furrows with an electric analog are presented. The data and analysis thereof are rather limited in extent and do not represent the completed project.

The wetted perimeter of a furrow was an important variable when considering the quantity of water which was discharged from it into the soil. A trial analysis was made using hydraulic radius as a variable but no greater significance was obtained.

The results indicated that the depth of soil below the furrow had little effect on the discharge.

The results are preliminary in that the analysis was based entirely on the assumptions that the soil profile was uniform, the furrow spacing was 30 inches, and the flow was steady state.

Future research will be conducted to determine the effects of furrow spacing, soil types, and soil variability within the profile.

U. Idaho, Col. Agr. Moscow, Idaho.

Ball, J. W. LIMITATIONS OF METERGATES. J. Irrig. and Drain. Div., ASCE 88(IR 4): 23-38. Dec. 1962.

Metergates of different sizes were tested to investigate their hydraulic characteristics and evaluate them as flow measuring devices. A research program was conducted on a 10-in. diameter plastic pipe with a square-edge flush entrance to add general information for analyzing the metergate tests. The shape of the gate, the nature of the gate seat and framing, the submergence of the metergate entrance, the confinement of the entrance, the flow velocity, and the location of the head-measuring well taps were found to influence the differential head that indicates the flow quantity. The tests indicated the effects and relative importance of these factors on flow measurement and gave the magnitude of errors that may result unless certain limitations of design and operation are observed. It was concluded that:

1. The metergate is an accurate water-measuring device, provided certain limitations are observed and the differential heads and gate openings are accurately measured.
2. It is important that the gate opening be known or set accurately; otherwise accurate discharge measurements are not possible.
3. Errors in discharge will be small for various sizes of metergates that are geometrically similar to the test installation that is used to obtain the hydraulic characteristics of the metergate.
4. All hydraulic characteristics for metergates with circular and square leaves are not the same. The discharge curves and tables for one are not applicable to the other, except at 100 percent gate openings.
5. Limiting the maximum gate opening to 50 percent will reduce to negligible proportions any error that would be introduced by a reasonable confinement of the entrance.
6. A metergate must have at least one pipe diameter submergence of the upstream end in order to eliminate the influence of small submergences, or the maximum gate opening must be limited to 75 percent in order to minimize this influence.
7. A metergate must have sufficient submergence of the downstream end of its pipe to provide a readable water surface in the head-measuring well.
8. The pipe length downstream from the gate should be at least seven pipe diameters in order to assure a reasonably uniform velocity distribution and minimum velocity at the exit, and in order to minimize erosion downstream.

9. Limiting the maximum gate opening to 75 percent will reduce to negligible proportions any error that would be introduced by mislocation of the downstream head-measuring well tap.
10. The present metergate design is not the optimum for flow measurement accuracy. The practice of placing the tap on the downstream head-measuring well 12 in. downstream from the gate makes each metergate size and setting a special problem requiring either strict operational limitations or individual calibration unless the maximum gate opening is limited to 75 percent.
11. For best over-all results, the tap to the downstream head-measuring well for the various gate sizes should be at geometrically similar locations and preferably where the hydraulic gradient is not steep. The tests indicated the optimum location to be in the crown of the pipe, approximately 1/3 pipe diameter downstream from the gate.
12. Usually, the viscosity influence is negligible for metergates and need not be considered.

Western Canada Hydrol. Lab., G. E. Crippen & Assoc. Ltd., Vancouver, British Columbia, Canada.

Kruse, E. G. DESIGN OF GRAVEL PACKS FOR WELLS. Trans. ASAE 5: 197-199. 1962.

Laboratory model studies were made to determine the criteria for proper selection of gravel packs with a range of uniformity coefficients and median sizes.

The tests showed that the following pack-aquifer (P-A) ratios are the largest permissible if excessive aquifer movement is to be prevented:

<u>Aquifer</u>	<u>Gravel Pack</u>	<u>Pack- Aquifer Ratio</u>
Uniform	Uniform	9.5
Uniform	Non-uniform	13.5
Non-uniform	Uniform	13.5
Non-uniform	Non-uniform	17.5

Initial sand movement increased with increasing aquifer uniformity coefficient at low P-A ratios. At high P-A ratios, sand movement increased with decreasing aquifer uniformity coefficient. Sand movement was reduced by increasing the uniformity coefficient of the gravel pack at all P-A ratios.

Surging of the P-A interface was also effective in reducing head losses.

SWCRD, ARS, USDA, Fort Collins, Colo.

Madison, J. H. TURFGRASS ECOLOGY: EFFECTS OF MOWING, IRRIGATION, AND NITROGEN TREATMENTS OF AGROSTIS PALUSTRIS HUDS., 'SEASIDE' AND AGROSTIS TENUIS SIBTH., 'HIGHLAND' ON POPULATION, YIELD, ROOTING, AND COVER. Agron. J. 54: 407-412. 1962.

The term verdure is proposed to symbolize quantitatively the green grass on the ground that equates to the stubble of forage but is the product of turfgrass culture.

Studies were made of the effect on turfgrass population of such management practices as fertilizing, mowing, and irrigating. This enabled yield, verdure, rooting, and chlorophyll to be evaluated in terms of both difference per unit area, and average difference per plant.

When results were compared to examples of forage studies, shorter and more frequent mowing increased the yield of turf (the part wasted), in contradiction to a reduced yield of forage. When the product of turf (verdure) was compared to the product of forage (yield), results were parallel. Similarly, roots per individual turf plant were reduced by fertility and short, frequent mowing, as are roots in forage studies. However, the interaction of large populations in turf resulted in inconsistencies between forage and turf when turf roots were evaluated on a soil-volume basis.

Frequent irrigation proved detrimental to turf.

When treatments stimulating growth (respiration) were combined (high nitrogen, frequent irrigation, and short or frequent mowing), growth was decreased and verdure was decreased. The alternate treatments combined (weekly irrigation, high weekly mowing, and less than maximum nitrogen) produced low yield but increased verdure. It is suggested that yield is decreased in one instance by exhaustion of carbohydrate, in the other by accumulation of carbohydrate.

Nitrogen fertilizer increased the population density without greatly affecting the size of individual plants. Shorter mowing and more frequent irrigation resulted in denser populations of smaller individuals.

U. Calif., Davis, Calif.

Bennett, O. L. IRRIGATION OF FORAGE CROPS IN EASTERN UNITED STATES. U.S. Dept. Agr., Agr. Res. Serv. Prod. Res. Rpt. 59, 25 pp. 1962.

It is extremely difficult to evaluate whether or not irrigation of forage pays under humid conditions. Prevailing market prices for livestock, milk, and hay; how the forage is used; cost of producing the forage and establishing and maintaining the irrigation system; availability of water; and management practices must all be considered.

The response of forage crops to irrigation will vary considerably from year to year and between seasons of a given year. Supplemental irrigation may be needed only occasionally during short drought periods or it may be needed almost continuously to produce grazing or forage for silage and hay.

Results from irrigation studies are reported and reports on irrigation studies in relation to forage crops produced in the humid areas are reviewed. Recommendations are given to those who plan to use an irrigation system.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Hall, V. L., and Tackett, D. L. GROWTH AND NUTRITIONAL BALANCE OF NATO RICE AS INFLUENCED BY TIME OF NITROGEN FERTILIZATION AND WATER MANAGEMENT. Ark. Agr. Expt. Sta. B. 662, 31 pp. 1962.

A 1-year field study was carried out at the Rice Branch Station, Stuttgart, using Nato rice. Nitrogen from ammonium sulfate was applied as a topdressing at four different stages in the growth of the rice plants.

Plant height, dry weight, and the nutrient status of the rice plant were influenced by a post-emergence topdressing of nitrogen fertilizer. The stage of development of the plant when it is topdressed is very important in the uptake of nitrogen and mineral elements.

While still relatively young and developing vegetatively, the rice plant will take up nitrogen from ammonium sulphate fertilizer without a simultaneous uptake of other mineral elements.

Near midseason (70 days after seeding) when the plant has changed from the vegetative to the reproductive cycle, the meristematic activity associated with the formation and development of the culm and panicle greatly increases nutrient uptake. Proper application of a nitrogen fertilizer at this time would influence the number of flowers on the panicle. Although these plants did not receive phosphorus or potassium as a supplemental fertilizer, these elements moved into the plants along with nitrogen during this period of panicle differentiation and development.

As the panicle became well developed (84 days after seeding) and approached emergence from the boot, the intake and other mineral elements changed to an uptake pattern similar to that found in plants fertilized at the early reproductive phase, 56 days after seeding.

The native fertility level of the flooded soil was sufficient so that both phosphorus and potassium were available in quantities necessary to maintain a relatively constant concentration in relation to the dry weight increase of the plants. This trend also was true for calcium, sodium, magnesium, manganese, and iron.

Before the plants were flooded initially, the level of nitrate nitrogen in the leaves of the young unfertilized plants was higher than that of ammonia nitrogen. After the initial flood, the nitrate nitrogen level in the leaves dropped within seven days.

While the field was allowed to dry before each fertilization the soil became well aerated. Upon reflooding after nitrogen top dressing with ammonium sulfate, sufficient air was trapped in the soil to allow biological transformation of some of the ammonium ion to the nitrate form. Nitrification continued while there was sufficient oxygen available. This period varied from 9 to 21 days, the longest time being associated with the last two top-dressings.

Nitrogen was the only element that was not maintained at a relatively constant concentration from the natural fertility of the soil. Supplemental nitrogen was needed.

From 7 to 14 days after the initial flood, the relative content of calcium, sodium, and iron increased to a maximum level in the plants. There was no rapid increase in plant height or dry weight at this time, so that the increase in calcium, sodium, and iron was a direct effect of flooding.

Regardless of the time of nitrogen fertilization, the percent phosphorus increased in all plants at 63 days. This was 28 days before the panicles emerged and was considered to be the beginning of the development and growth of the reproductive stem and panicle in the Nato rice plant.

There were three significant, positive, concomitant relationships among the nitrogen fractions in the panicles of the rice regardless of when the plants were fertilized with nitrogen. These were: (1) Total nitrogen and total assimilated nitrogen; (2) total soluble nitrogen and both ammonia and soluble organic nitrogen; and (3) ammonia nitrogen and soluble organic nitrogen.

Lodging of plants 18 days before harvest affected maturation of the grain. This was expressed in the seed as lighter weight, higher percentages of hulls and bran, and a lower percent of whole polished grain.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark.

Cowan, R., Hoover, M., Marsh, A. W., Krantz, B. A., and Richards, S. J. WATER, NITROGEN AND VARIETIES IN LOWER DESERT COTTON PRODUCTION. Calif. Agr. 16(11): 10-12. 1962.

Cotton frequently grows rank and unproductive in the Palo Verde Valley of California. Both irrigation and fertilization practices contribute to the growth and fruiting behavior of cotton. How much each factor contributes to rankness and how each may be employed to control vegetative growth and still secure high lint yields were studied.

Lint yields of Acala 4-42 were highest (despite some lodging) when plants received only adequate supplies of nitrogen and water. When the nitrogen fertility level was adequate for maximum yields, excessive irrigations produced such rank cotton with large amounts of boll rot that resulting yields were lower than those obtained under nitrogen deficiency conditions. Deltapine Smooth Leaf variety also grew more rank when given extra amounts of both water and nitrogen, but boll rot was not severe and yields were not depressed. Deltapine Smooth Leaf performed better than Acala 4-42 under all conditions tested and required less strict attention to irrigation and nitrogen fertilizer for maximum lint yields than Acala 4-42.

M. Hoover, Extension Cotton Specialist, U. Calif., Riverside, Calif.

Turney, J. R., and Ellis, H. H. STATE WATER-RIGHTS LAWS AND RELATED SUBJECTS. U.S. Dept. Agr., Econ. Res. Div. Misc. P. 921, 198 pp. 1962.

This bibliography was prepared as an aid to those searching available literature on the subject of State water laws.

Publications dealing with water laws and related subjects in one region are of value to those concerned with such problems in other regions. Such publications include legal, economic, and related analyses. Special effort was made to achieve comprehensive coverage of publications dealing with State water-rights laws. Complete coverage of literature on related topics was not attempted, and discussions of various aspects of water law that appear in legal encyclopedias and in text or case books on real property or other subjects are not cited.

MOS, USDA, Inform. Div., Washington, D.C. 20250.

Drainage

Donnan, W. W., and Aronovici, V. S. PLASTIC-LINED MOLE DRAINS FOR IRRIGATED AREAS. J. Irrig. and Drain. Div., ASCE 88 (IR 4): 39-42. Dec. 1962.

The need for a low-cost subsurface drainage device for agricultural lands has prompted the development of plastic-lined mole drains. These drains are installed at depths of approximately 30 in. Field tests were made of this drain device at seven locations in irrigated areas of the western United States to determine their feasibility under irrigated conditions. Observations made over the 3-yr. period were:

1. Poor vertical grade alignment was observed near the outlet end of all lines installed in the spring of 1959. Beyond 10 ft. to 15 ft. of installation, the grade alignment was satisfactory, provided the land was previously leveled and graded.
2. The two test plots located on sandy soils failed immediately after installation. The type of the plastic liner installed does not provide adequate filtering to prevent entry of fine sands and silts into the tube. This allows either clogging of the drain or total collapse.

3. In the fine-textured soils, the installations were initially substantially successful. Examination with the electronic devices indicated that a 2.7 in. to 3.0 in. diameter, round plastic mole liner was installed.
4. Two of the drain systems installed in the clay soil were subsequently completely destroyed as a result of the crushing of the lines by heavy machines. When cross ditches and dikes must be installed, they should be built immediately.
5. Improvements should be made in the installation machine and in the plastic material so that the present tendency for frequent breakdowns can be eliminated. The plastic liner breaks, or gets jammed and breaks, at the 90° bend on the installation device.
6. Outlet tubes should be installed as soon as possible after completion of the plastic drain to guard against outlet erosion. The slits and holes on the 10 ft. of drain outlet should be sealed with mastic tape prior to installation. Crimping of the outlet end during the installation of the outlet tube should be avoided.
7. One test plot was located on a highly saline clay soil. The area was immediately planted to rice and water was ponded over the drains for 120 days. The drains produced a good flow of water and succeeded in removing 15 tons of salts per acre from the area.
8. The outstanding success of the leaching trials points the way toward the adaptation of the lined mole drain as a useful tool for reclamation of salt affected soils.
9. The depth limitation problem of lined mole drains in irrigated areas of the West must be solved before widespread adoption of this tool can be forthcoming. In areas in which the inherent ground waters are saline, drainage devices at a depth of only 30 in. offer only a minimum protection to the root zone of the plants. If the installation device could be constructed in order to lay the drains at the 42-in. to 50-in. depth, this technique might have considerable acceptance in areas of the western United States:

SWCRD, ARS, USDA, Riverside, Calif.

Larson, C. L. and Manbeck, D. M. TILE FLOW AND POWER USE DATA FOR PUMP DRAINAGE SYSTEMS. Trans ASAE 5: 207-209. 1962.

Field and laboratory studies were started in 1955 at the Minnesota Agricultural Experiment Station to study: (1) Flow rates for design of drainage pumping plants; (2) annual power requirements; and (3) factors affecting the efficiency, reliability, and cost of pump drainage systems. Reports on 7 years of field studies on the first two of these objectives are given.

For surface and subsurface drainage of mineral soil, it was found that a 5-year recurrence interval gave a drainage coefficient of approximately 3/4 in. per day. For organic soil with surface and subsurface drainage, the corresponding value was slightly lower, but not significantly different. In both cases, the tile spacing was primarily 100 ft. For organic soil and subsurface drainage with a predominant tile spacing of 200 ft., the 5-year rate of flow was between 1/2 and 5/8 in. per day.

Maximum amounts of precipitation, tile flow, and power use at the two surface and subsurface drainage sites occurred during the month of June. High flow also occurred in April at the site where pumping was discontinued during the preceding winter.

Conclusions on annual power use are based on 7 years of record at 26 pumping plants. Annual power use varied considerably from year to year, and from one unit to another, depending on many factors. The annual power use was about 17 k.w.h. per acre for the surface and subsurface drainage systems and about 26 k.w.h. per acre for those with subsurface drainage only. These means are not significantly different at the 5-percent level of significance because of the large variations between the plants.

U. Minn., St. Paul, Minn.

Meyer, J. L., Werenfels, L., Scott, V. H., Luthin, J. N., and Abu-Zied, M. DRAINAGE BY PUMPED WELLS. Calif. Agr. 16(8): 10-12. 1962.

Investigations on the west side of the San Joaquin Valley indicated that wells carefully located at sites of good aquifer characteristics can be pumped effectively to control water tables over a limited area. Previous experience by local irrigation districts had led to the belief that drainage by pumped wells was unreliable in this area of fine-textured alluvial soils of sedimentary origin. This type of drainage can become physically feasible where there are no perched or confined water tables. Application of this method depends on economic considerations, such as the possibility of reusing the water.

P. O. Box 1414, Scenic Drive and Old Oakdale Road, Modesto, Calif.

Hermesmeier, L. F., and Larson, C. L. LAND FORMING: GRADE AND ROW-LENGTH STUDIES IN THE RED RIVER VALLEY. Trans. ASAE 5: 172-174, 179. 1962.

The Red River Valley area of Minnesota and North Dakota is distinctive because it has definite drainage problems despite a well-distributed annual rainfall of only 20 to 24 in. This is true primarily because of the long periods of frozen soil, the deep clay soils, and of the unusually flat topography. Slopes of 2 to 5 feet per mile are quite common in this area.

The necessity of outlet ditches was recognized early, and ditches now crisscross the area at one-mile or half-mile intervals. Since World War II, many farmers have constructed field ditches to drain the shallow depressions which still remain. Recently, the land plane has come into use to smooth out headlands, deadfurrows, and minor natural irregularities.

"Land forming" is defined as changing the topography of a field to insure the orderly movement of water over the land. It goes beyond the above-mentioned practices since it involves reshaping the entire field surface. High spots are cut down and depressions are filled in to create a continuous grade to a field or outlet ditch.

Whether land forming is worth while in the Red River Valley was studied. The objectives were to determine for this area: (1) The optimum combination of length and percent of grade; (2) the effect of topsoil removal on crop yields; (3) effect of heavy earth-moving equipment on soil compaction; and (4) the benefits as compared to cost of land forming.

The cost of construction, depth of top soil removal, and depth of available outlets were the significant factors affecting the selection of the optimum grade and row length when land forming was used. The volume of earth moving required for land forming increased with both the change in grade and increase in length of slope. It also depended on the irregularity of the ground surface. Crop yields, average soil moisture, and soil temperature were not significantly affected by grade or length.

Soil moisture was more uniform on land forming plots and operation of field machinery was better. Seeding was possible earlier in the spring and tillage was possible sooner after rains. Land forming tended to increase average yields by increasing yields on former depressed wet areas in the field and permitting more timely farming of the remaining parts of the field.

Soil compaction was increased temporarily by land forming. Deep cut areas with normal or less fertilizer applications produced considerably decreased yields. Heavy fertilizer applications on these areas of deep cut restored yields to normal levels. No water erosion was noted with rows 640 ft. long on a 0.5 percent grade. No special problems were encountered with farming across the field drains.

SWCRD, ARS, USDA, Morris, Minn.

Harris, C. I., Erickson, H. T., Ellis, N. K., and Larson, J. E. WATER-LEVEL CONTROL IN ORGANIC SOIL, AS RELATED TO SUBSIDENCE RATE, CROP YIELD, AND RESPONSE TO NITROGEN. *Soil Sci.* 94: 158-161. 1962.

Controlled water-level experiments on organic soil in northern Indiana over a 16.6-year period showed that subsidence rate was directly related to depth of water table, and that subsidence rate decreased with time. Average subsidence rates of 0.79 and 0.36 inches per year were found, respectively, for the 40- and 16-inch water tables.

Onion, potato, peppermint, carrot, and corn yields were greatly reduced by the 16-inch water table as compared with yields obtained on the 24-, 32-, and 40-inch water tables, which were essentially the same.

Crop response to nitrogen was limited mainly to the 16-inch water table, with potatoes and corn showing the greatest response.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Storage and Conveyance

Moh, Z. SOIL STABILIZATION WITH CEMENT AND SODIUM ADDITIVES. *J. Soil Mechanics and Found. Div., ASCE* 88 (SM 6): 81-105. Dec. 1962.

The mechanisms by which a group of alkali metal compounds improves the stability of cement or lime stabilized soils was studied. The types and trends of the interaction among the soil constituents and admixtures was studied rather than the exact chemical formulation of the final products. Mixtures of mono-mineral soils (quartz, gibbsite, and kaolinite), cementing compounds (hydrated lime, tricalcium silicate, and portland cement) and selected sodium additives (hydroxide, metasilicate, and sulfate) were examined during the curing period by a number of special analytical techniques, including X-ray diffraction, differential thermal analysis, flamephotometry, and colorimetry.

All mono-mineral soils tested reacted with the calcium stabilizers. Addition of sodium additive greatly intensified the reaction between the soil and cementing compound, and increased the abundance of reaction products. The reactions between any mono-mineral soil with the three calcium stabilizers, and the effect of sodium additives on these reactions did not differ greatly. The major differences were more in the relative quantities of the various reaction products rather than the formation of entirely different reaction products.

Regardless of the type of the anion associated with the added sodium compound, the major consequences of the incorporation of such compounds into a soil-cement mixture are: (1) An increase of pH, or increase in available hydroxyl ion concentration in the pore fluid; (2) a marked reduction in the calcium ion concentration; and (3) a marked increase in the sodium-calcium ratio in solution.

The ultimate results of these effects are: (1) An increased rate and extent of solubilization of soil silica; (2) retardation of precipitation of calcium silicate gel; and (3) formation of highly hydrated silicate gels containing a substantial quantity of sodium.

These phenomena led to the production of an increased volume of, and more widely distributed, cementitious gel than would have been produced from soil-cement alone. The sodium additives improved the stability of soil-cement by increasing the quantity and uniformity of distribution of the cementitious reaction product. Explanations are offered for: (1) The different effect of various sodium additives on different soil types; (2) the unique effect of sodium sulfate on cement-stabilized organic sands; (3) the improvement of the soil-cement to sulfate attack; and (4) the long-term stability of additive treated soil-cement by considering the concurrent reactions occurring within the soil-cement system.

Yale U., New Haven, Conn.

Johnson, H. P., Jacobson, P., and Schwab, E. O. LEAKAGE FROM SMALL RESERVOIRS AS AFFECTED BY POLYPHOSPHATE AND BENTONITE TREATMENT. Trans. ASAE 5: 200-201, 203. 1962.

The field observations of reservoir leakage illustrates the nature of the problem in reservoir construction in the deep loess area of western Iowa. The combined effect of polyphosphate or bentonite treatment and compaction considerably reduced the rate of water loss from reservoirs. However, the small amount of surface runoff at certain locations, the lack of base flow, and the continued, though reduced rate of leakage from the reservoir indicates that the problem is not solved by bentonite or polyphosphate treatment as used.

At present no adequate method of predicting when a reservoir will hold water has been developed. It appears that two conditions prevail where severe leakage occurs: (1) Where no water table is encountered and the loess is very deep; and (2) where sand or gravel strata are found below the reservoir area and no water table is encountered. Sufficiently deep borings made in the reservoir area would help identify these conditions.

SWCRD, ARS, USDA, Des Moines, Iowa.

BASIC SOIL SCIENCE

Soil Physics

Benoit, R. E., Willits, N. A., and Hanna, W. J. EFFECT OF RYE WINTER COVER CROP ON SOIL STRUCTURE. Agron. J. 54: 419-420. 1962.

The inclusion of a rye winter cover crop in an intensive cash crop program can improve or maintain soil structure. Beneficial changes in the soil physical condition are associated primarily with the plant roots. Incorporation of plant tops alone effected no measurable change in the soil's physical condition. Roots and tops together had the most pronounced effect, but not until after three successive years of cover crop additions. The favorable effects of the cover crop on the physical condition of the surface soil were carried over into the subsoil.

N.J. Agr. Expt. Sta., Rutgers, The State U., New Brunswick, N.J.

Smalley, R. R., Pritchett, W. L., and Hammond, L. C. EFFECTS OF FOUR AMENDMENTS ON SOIL PHYSICAL PROPERTIES AND ON YIELD AND QUALITY OF PUTTING GREENS. Agron. J. 54: 393-395. 1962.

Additions of vermiculite and colloidal phosphate to an Arredondo lfs improved growth and quality of Tifgreen bermudagrass on experimental putting greens, while fired clay generally reduced grass yield and quality. Peat had little effect upon grass response. Depth of mixing treatments had no significant effect upon grass growth or physical soil conditions.

Plots amended with fired clay and peat contained a higher percentage of noncapillary pore space than soils amended with vermiculite or colloidal phosphate. Fired clay was the only tested material in soil mixtures that effectively increased hydraulic conductivity. Mixtures containing colloidal phosphate had the lowest hydraulic conductivity of those tested. There was an average decrease in hydraulic conductivity for all plots of 1.85 inches per hour from 1960 to 1961.

Bulk density of field and compacted samples proved a poor measure of the grass-producing ability of soil mixtures. However, hydraulic conductivity gave a good indication of grass-producing potential since the turf yield and quality decreased as hydraulic conductivity increased from 3 to 13 inches per hour.

Tested amendments were ineffective in changing the penetrability of the top inch of the experimental green. The yield and quality of bermudagrass improved as the force required for penetration of the 2- to 4-inch depth decreased.

Plantation Field Lab., Ft. Lauderdale, Fla.

White, E. M. VOLUME CHANGES IN SOME CLAY SOILS. *Soil Sci.* 94: 168-172. 1962.

The surface height of some soils derived from Pierre shale in western South Dakota decreased 1 to 1.34 inches in the upper 2 feet as the profile dried. The surface height did not decrease at the same rate within a distance of a few yards. Bulk densities determined by weighing large measured volumes from soil layers in the field are less affected by volume changes caused by fluctuations in the moisture content than bulk densities determined from clods. Bulk densities determined in the field and from clods can be used to calculate the volume of desiccation voids formed between structure units as a soil dries. No marked differences were found in soils with or without gilgai by the volume-change methods. Minerals found in 100 cm.³ of soil at field capacity would be concentrated into structure units with a volume of 70 cm.³ when the soil is air-dry.

S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

Wiersum, L. K. UPTAKE OF NITROGEN AND PHOSPHORUS IN RELATION TO SOIL STRUCTURE AND NUTRIENT MOBILITY. *Plant and Soil* 16: 62-70. 1962.

Nitrogen and phosphate uptake by young plants was studied, using artificial aggregates of different sizes. Large impenetrable aggregates brought about coarse rooting, while in the finer substrates dense root growth was possible. Coarse rooting resulted in diminished uptake of the mainly immobile stock of phosphate. Nitrate uptake was hardly influenced by rooting density on account of its high mobility and transport along with the extracted water. On the finer substrates, the plants absorbed more phosphate and therefore the N/P ratio was lower.

Implications of this effect of soil structure on uptake are indicated.

Inst. Soil Fertility, Groningen, The Netherlands.

Phillips, R. E., and Kirkham, D. MECHANICAL IMPEDANCE AND CORN SEEDLING ROOT GROWTH. *Soil Sci. Soc. Amer. Proc.* 26: 319-322. 1962.

Using needle penetration and bulk density as measures of mechanical impedance, the effects of mechanical impedance on corn seedling root growth were studied in the laboratory. The corn seedlings were grown in artificially compacted samples of a *Colo c* where the moisture was at a tension of 10 cm. in some samples and 100 cm. in others. The rate of corn seedling root elongation decreased linearly as bulk density of *Colo c* increased from 0.94 g. per cc. to 1.30 g. per cc., or as needle penetration into the *Colo c* decreased. In other laboratory experiments, the depth of corn seedling root penetration into sand contained in glass tubes of differing diameters was found to be linearly related to the depth of penetration.

From the measurements of plant roots and of soil physical properties, it was concluded that soil compaction and not aeration reduced corn seedling root growth through the mechanism of mechanical impedance when the corn seedlings were grown at a constant temperature, 25°C., for a period of approximately 1 week in Colo. c. This conclusion does not imply that aeration or other physical properties would not limit the corn growth had it been continued, during later stages of its physiological development.

U. Ark., Fayetteville, Ark.

Mazurak, A. P., and Ramig, R. E. AGGREGATION AND AIR-WATER PERMEABILITIES IN A CHERNOZEM SOIL CROPPED TO PERENNIAL GRASSES AND FALLOW-GRAIN. Soil Sci. 94: 151-157. 1962.

The second 10-year cycle of a grass rotation experiment on a chernozem soil was completed. Intermediate wheatgrass (Agropyron intermedium) and brome grass (Bromus inermis) were sown in pure stands on two fallow plots every second year. Eight plots in 4 replicates were in each grass for 2, 4, 6, and 8 years. Every spring one member of each pair of plots received 40 pounds of nitrogen per acre. One half of each plot was mowed and the grass removed, while the other half was mowed and the grass clippings left on the plot. Plots in sod for 20 years and in fallow-grain sequences were available for analysis.

Several physical properties of the surface soil were improved as the length of time that grass was grown on the area was increased. As the age of the grass increased, the geometric mean diameter of dry aggregates decreased up to the 6th year and then increased. The decrease in aggregate diameter was attributed to the roots breaking up the clods. The increase in the geometric mean diameter of air-dry aggregates after the 6th year was associated with the mechanical binding of roots on soil particles.

Geometric mean diameter of water-stable aggregates increased curvilinearly with the age of grass. Values of hydraulic conductivity and air permeability on disturbed soil columns increased likewise as the age of grass increased. The ratios of air to water intrinsic permeabilities for the soil columns were constant with the age of grass. This indicates that the water stability of aggregates was not associated with any temporary chemical effect, but was associated with the cementing effect of organic matter.

Application of nitrogen fertilizer did not affect the measured physical properties of Holdrege sil. Leaving grass clippings on the plots increased the geometric mean diameter of air-dry aggregates.

U. Nebr., Lincoln, Nebr.

Skrepinskiy, A. I. CHARACTERISTICS OF THE AGGREGATION OF SOILS IN THE SOUTH-EAST. Soviet Soil Sci. 2: 136-141. Feb. 1961.

The characteristics of the formation of biological aggregation of soils were studied in Russia. It was concluded that:

1. There are three types of biological aggregation processes in soils: the root, rhizospheric, and intestinal types. In the root type of aggregation, the roots take a direct part in the formation of aggregates > 3 mm. in diameter. The rhizospheric type takes place in the rhizosphere, whereby aggregates 2-0.5 mm. in diameter form. In the intestinal type the aggregates form in the intestinal tracts of certain burrowing animals. All three types of aggregation take place simultaneously, but one of the

types may predominate over the others, depending on the combination of soil-formation factors.

2. In Southeast Russia, soil aggregates form primarily by rhizospheric aggregation, which leaves an impression on the time and rate of aggregation, and the shape and sizes of the forming aggregates.
3. With the rhizospheric type of aggregation there is no qualitative difference between perennial grasses and annual row crops as structure-forming agents. The soil in the Southeast can be aggregated both under fallow row-crop rotation and under a grass-arable system under proper agricultural practices.

Scripta Technica Inc., Washington, D.C., 20005.

Cohen, O. P., and Strickling, E. EVALUATION OF AIR-TO-WATER PERMEABILITY RATIO FOR MEASURING DIFFERENCES IN SOIL STRUCTURAL STABILITY UNDER TEN CROPPING SYSTEMS. Soil Sci. Soc. Amer. Proc. 26: 323-326. 1962.

Aggregate and structural stabilities were determined on samples taken under 10 cropping systems on Beltsville sil soil. Water stability of aggregates from 2 mm. to 4.76 mm. in diameter was measured by the wet-sieving method of Bryant and others. Structural stability was determined on samples < 2 mm. and < 1 mm. by the air-to-water permeability ratio method of Reeve. The measurement of soil aggregate stability by wet-sieving distinguished six different groups of cropping systems according to Duncan's Range Test. The order of placement of the cropping systems was in agreement with other experimental results of Wilson and coworkers, concerning the effect of cultivation and forage crops on aggregate stability. The measurement of structural stability by the air-to-water permeability ratio method did not distinguish soil structural differences associated with the cropping systems. Attempts to increase the sensitivity of the air-to-water permeability ratio failed. Water permeability offers some promise as a measurement of structural stability differences associated with cropping systems.

Jr. Author, U. Md., College Park, Md.

Miller, D. E., and Kemper, W. D. WATER STABILITY OF AGGREGATES OF TWO SOILS AS INFLUENCED BY INCORPORATION OF ALFALFA. Agron. J. 54: 494-496. 1962.

Alfalfa was incorporated at several rates with coarse-textured and fine-textured soils under field and laboratory conditions. Water stability of the 1- to 2-mm. aggregates increased in all cases. The increase was greatest in those samples that were not stored for long periods before analysis.

Under field conditions, increased water stability of the aggregates following alfalfa incorporation was observed for at least one growing season, after which it decreased. Most of the increase in water stability was obtained within a few weeks after incorporation of the alfalfa.

In the coarse-textured soil, the incorporation of alfalfa roots and stubble was as effective in increasing water stability of the aggregates as incorporation of a full crop of alfalfa.

SWCRD, ARS, USDA, Prosser, Wash.

van Bavel, C. H. M., and Harris, D. G. EVAPOTRANSPIRATION RATES FROM BERMUDAGRASS AND CORN AT RALEIGH, NORTH CAROLINA. *Agron. J.* 54: 319-322. 1962.

During 1956-58 maximum evapotranspiration was measured on bermudagrass and during 1957-58 on corn. Measurements were made during the growing season in percolation type lysimeters. The lysimeters were located in test areas treated in a manner similar to the lysimeters themselves.

Evapotranspiration was also computed from pertinent weather data collected at the test site using Penman's formula and two simplifications of it. Generally all estimates used gave reasonable agreements with observations over long periods of time, the Penman formula in complete form tending to yield too high values. Over shorter periods of time--several days in length--estimates were less reliable.

Evapotranspiration rates from bermudagrass and corn did not differ materially but corn showed marked effects of stage of growth, as contrasted to grass.

SWCRD, ARS, USDA, Raleigh, N.C.

Doss, B. D., Bennett, O. L., Ashley, D. A., and Weaver, H. A. SOIL MOISTURE REGIME EFFECT ON YIELD AND EVAPOTRANSPIRATION FROM WARM SEASON PERENNIAL FORAGE SPECIES. *Agron. J.* 54: 239-242. 1962.

The effect of 3 soil moisture regimes on yield and water-use of dallisgrass, sericea lespedeza, bahiagrass, Coastal bermudagrass, and common bermudagrass was determined on a Greenville fsl soil during the 1956-58 growing seasons. The 3 soil moisture regimes were established by irrigating when 30 percent (M_3), 65 percent (M_2), and 85 percent (M_1) of the available soil moisture had been removed from the surface 24 inches of soil.

The average yield for the 3-year period, for all species except sericea, increased as available soil moisture increased. The average yield for sericea was highest at the M_2 moisture regime. Coastal bermudagrass was the most productive for the 3-year period at all moisture regimes while dallisgrass was the least productive. Average annual yields of all species for the 3-year period were 8,631 pounds for M_1 , 9,436 pounds for M_2 , and 9,954 pounds for M_3 .

Average daily evapotranspiration rates were 0.09 for M_1 , 0.16 inch for M_2 , and 0.17 inch for the M_3 regime with little difference between species. The total amount of water used depended more upon the amount of available moisture in the soil than on plant species. All species used considerably more water before clipping than after. Moisture was first extracted at a shallow depth beneath the plant and then extracted at successively lower depths as the moisture supply was depleted.

SWCRD, ARS, USDA, Thorsby, Ala.

Fritschen, L. J., and van Bavel, C. H. M. ENERGY BALANCE COMPONENTS OF EVAPO-RATING SURFACES IN ARID LANDS. *J. Geophysical Res.* 67: 5179-5185. 1962.

The components of the surface energy balance equation $R_n + S + (S' \text{ or } W) + LE + A = 0$ were determined during April and May 1961 in experiments conducted over an extended wet, bare soil surface and over an extended area of shallow water in the vicinity of Phoenix, Ariz. Evaporative flux (LE) measurements were found from sensitive weighing lysimeters. Net radiation (R_n) was measured with miniature net radiometers. Soil heat flux (S) was measured with heat-flow transducers. The change in energy storage of the layer of soil (S')

or water (W) above the heat-flow transducer was computed using direct measurements of soil or water temperature. The sensible heat flux into the air (A) was determined by solving the energy balance equation. The results of triplicate measurements made every 15 minutes for 9 consecutive days indicated that the daily totals of the sensible heat flux to the air were generally negative, that is, away from the surface. The rate of evaporation was larger from a wet soil surface than from a free water surface. On days of similar solar radiation, the evaporative flux tended to be correlated with wind speed.

SWCRD, ARS, USDA, Tempe, Ariz.

Arkley, R. J., and Ulrich, R. THE USE OF CALCULATED ACTUAL AND POTENTIAL EVAPOTRANSPIRATION FOR ESTIMATING POTENTIAL PLANT GROWTH. *Hilgardia* 32(10): 443-470. 1962.

Potential evaporation (ET_p) can readily be calculated from monthly mean temperatures by means of tables and nomograms now available in the literature. Actual evapotranspiration (ET_a) is calculated from ET_p by taking precipitation and the waterholding capacity of the soil into account. Either value can be calculated for the whole year (ET_p or ET_a), if frost-tolerant plants are under consideration; or for the frost-free period ($ET_p^{32^\circ}$ or $ET_a^{32^\circ}$) if frost-sensitive plants are under consideration.

All four values-- ET_p , ET_a , $ET_p^{32^\circ}$ and $ET_a^{32^\circ}$ --were calculated for 211 California stations and for 27 Nevada and Oregon stations near California. Plotting these values for 25 stations along a traverse through central California and western Nevada revealed great differences from coast to inland stations, and from low to high altitudes. Comparison of the values with natural vegetation and with crops in the different regions indicated that the values are useful as indexes of expected growth of cultivated crops, range, and forest. ET_p values are useful if moisture is not limiting, as in humid climates or where irrigation water is available; ET_a values are useful for predicting the suitability of a climate for dry-farmed crops, estimating the potential for increased growth obtainable by irrigation, and for more precise studies of the effects of climate on natural vegetation. The indexes, used together, can be helpful in crop selection and other soil-management decisions.

Isograms of the four ET values, based on all California stations and plotted on maps of the state, furnish much information about those climatic limitations on plant growth that involve moisture and temperature relations.

Agr. Pub., Room 207 U. Hall, 2200 U. Ave., Berkeley 4, Calif.

Dutt, G. R., and Tanji, K. K. PREDICTING CONCENTRATIONS OF SOLUTES IN WATER PERCOLATED THROUGH A COLUMN OF SOIL. *J. Geophysical Res.* 67: 3437-3439. 1962.

A procedure was developed for calculating the concentration of solutes present in waters leached through soils containing gypsum and exchangeable Ca^{++} and Mg^{++} . A program of the procedure, prepared for a 1620 IBM computer, was used to predict the concentration of solutes in the effluent from a Yolo clay-loam soil that was being leached with a 0.025 N $MgCl_2$ solution. The theoretical results were compared with experimentally determined values. Diffusion of Mg^{++} caused variation between some of the calculated and measured values; the predicted values, however, were sufficiently close to the measured concentrations to be useful in most investigations.

U. Calif., Davis, Calif.

Denmead, O. T., Fritschen, L. J., and Shaw, R. H. SPATIAL DISTRIBUTION OF NET RADIATION IN A CORN FIELD. *Agron. J.* 54: 505-510. 1962.

By means of a network of 18 miniature net radiometers, net radiation was measured above, below, and within the canopy of a corn crop planted in hills spaced 40 inches X 40 inches at a population of 15,700 plants per acre.

Daily totals of net radiation near the ground and at 1 m. above the ground were plotted to give the patterns of shading at these levels within the canopy. Mechanical integration of the regions bounded by the various isolines was employed to obtain the average values of net radiation at various heights. At the start of the measurement period, July 11 (a few days before tassel emergence), the average net radiation near the ground was 42% of the net radiation measured above the crop. More of the soil surface was shaded as the corn grew and the sun moved further south. After the corn had developed its maximum leaf area, 25% of the net radiant energy measured above the crop was expended at the ground and 75% was expended within the canopy. Some 73% of the energy exchanged within the crop was exchanged with the upper half of the canopy.

There was a difference in net radiation distribution between days which were mainly clear and days which were mainly cloudy. On cloudy days, relatively less energy was expended within the upper part of the canopy, and relatively more within the lower part and at the ground.

Since net radiation represents the energy available for the evaporation of water, evaporation of water from the soil surface should be proportional to the energy expended at the ground and transpiration of water from the crop should be proportional to the energy expended within the crop canopy. Over a period of 19 days after maximum leaf area development, soil moisture determinations in plastic-covered and uncovered plots indicated that evaporation accounted for 23% of the evapotranspiration and transpiration accounted for 77%. This is much less than for the whole season where evaporation was estimated to be up to 50% of the total. In this same 19-day period, the energy expended at the ground constituted 27% of the net radiation above the crop and the energy expended within the crop canopy constituted 73%.

It was estimated that closer row spacing than 40 inches could increase the energy available to the crop for photosynthesis by 15- to 20%. Some of the implications of closer row spacing for evapotranspiration and the efficiency of water use are discussed.

L. J. Fritschen, SWCRD, ARS, USDA, Tempe, Ariz.

Olsen, S. R., Watanabe, F. S., Kemper, W. D., and Clark, F. E. EFFECT OF HEXADECANOL AND OCTADECANOL ON EFFICIENCY OF WATER USE AND GROWTH OF CORN. *Agron. J.* 54: 544-545. 1962.

Hexadecanol and octadecanol were added to a soil in which corn was grown to determine whether these materials exerted a moisture-conserving effect on the plant. The amount of water used per unit of dry matter production did not decrease following the addition of either hexadecanol or octadecanol to the soil. The amount of water transpired per unit of dry weight increased significantly with rate of alcohol addition with the mixed placement but it was not affected by the band placement.

Both alcohols reduced the yield of corn significantly when they were mixed with the soil at the rate of 25 g. per 3 kg. soil. In a band placement, only the octadecanol caused a reduction in yield compared to that in the untreated soil.

Considerable decomposition of the added alcohols occurred during nearly 2 months of exposure to the soil. None of the alcohol could be recovered from the soil receiving 1-g. treatments per pot.

SWCRD, ARS, USDA, Fort Collins, Colo.

Wiegand, C. L. DRYING PATTERNS OF A SANDY CLAY LOAM IN RELATION TO OPTIMAL DEPTHS OF SEEDING. *Agron J.* 54: 473-476. 1962.

The moisture content at various depths in the seed zone was determined periodically during an extended, rainless summer period following irrigation of Hidalgo scl. The moisture distribution in soil columns prepared from the same soil, but dried in the laboratory at 30°C. and 30% relative humidity, was determined. The results emphasize the importance of proper depth of planting to insure moisture for germination and proper design of planting equipment.

The moisture distribution with depth was found to be parabolic.

The moisture content at given depths in the seed zone was expressed by $\theta = a t^{-b}$, where θ is the moisture percentage, t is time in days since irrigation, a is the moisture content at the given depth one day after irrigation, and b is the slope of plots of moisture content versus time on log-log coordinates. The equation may be used for estimating moisture contents for periods longer than those studied and for calculating the rate at which the moisture content of the soil at particular depths is changing.

Planes of equal moisture content advanced into the soil linearly with time.

SWCRD, ARS, USDA, Weslaco, Tex.

Jackson, L. P. THE RELATION OF SOIL AERATION TO THE GROWTH OF POTATO SETS. *Amer. Potato J.* 39: 436-438. 1962.

The relation of soil water content and oxygen diffusion rate to growth of potato sets was investigated using soil columns of heights from 2 inches to 22 inches above a constant water table. The close relation between soil water content, air supply, and satisfactory growth of potato sets was demonstrated.

Optimum growth of potato plants was obtained when oxygen diffusion rate was 62.9×10^{-8} gr./cm.²/min. and soil moisture content was 14.1 percent.

In locations where water infiltration is slow or where temporary ponding on the surface is a problem, the accompanying reduction in soil aeration exerts a harmful effect upon newly planted sets and becomes a limiting factor in successful potato growth.

Canada Dept. Agr., Nappan, Nova Scotia, Canada.

Van Diest, A. EFFECTS OF SOIL AERATION AND COMPACTION UPON YIELD, NUTRIENT TAKEUP AND VARIABILITY IN A GREENHOUSE FERTILITY EXPERIMENT. *Agron. J.* 54: 515-518. 1962.

Dry matter yield and nutrient accumulation of corn were little affected by aeration and compaction applied to potted soil. Variability among replicate determinations of biological

indices was sharply increased by compaction of fertilized soil. Compaction lowered oxygen diffusion rates, increased bulk density, but did not affect root production and distribution.

N.J. Agr. Expt. Sta., Rutgers, the State U. N. J., New Brunswick, N.J.

Letey, J., Stolzy, L. H., Valoras, N., and Szuszkiewicz, T. E. INFLUENCE OF SOIL OXYGEN ON GROWTH AND MINERAL CONCENTRATION OF BARLEY. *Agron. J.* 54: 538-540. 1962.

Techniques for varying soil oxygen in studies involving grasses are described. Vegetative growth of barley was found to be rather insensitive to low soil oxygen. Oxygen diffusion rates of approximately 15×10^{-8} gm. cm.⁻² min.⁻¹ were limiting for barley root growth whereas the optimum diffusion rate for shoot growth was less than 40×10^{-8} . Low oxygen decreased the concentration of K and P in the shoot, but Na and Ca+Mg were not greatly influenced by the oxygen treatment.

U. Calif., Riverside, Calif.

Canham, A. E. SOIL TEMPERATURE AND PLANT GROWTH. In *ADVANCES IN AGRICULTURAL SCIENCE AND THEIR APPLICATIONS*. Proc. 25th International Hort. Cong. Nice, 1958. II: 440-451. 1962.

The environment of the root is often given less attention than that of the stem, particularly in respect of temperature. Little experimental data are available on the effects of soil temperature on plant growth. It is, an important factor in both the propagation and growing stages and, if it is sub-optimal, the efficiency of the processes of rooting and growth is diminished.

Earlier research work was briefly reviewed and results of preliminary experiments with tomato plants grown under controlled soil temperature conditions were presented. These show large differences in dry weight and nutrient uptake over the range 45° F. to 66° F., and similar variations were obtained with sweet corn and gladioli. Additional results from field experiments with electrically warmed soil are included which show how increased soil temperatures result in the earlier flowering of bulbs.

Root temperature can have a significant effect on plant growth and is a factor which should not be neglected if partial environmental control is to have the maximum effect.

Shinfield Green, Berks, England.

Milligan, V., Soderman, L. G., and Rutka, A. EXPERIENCE WITH CANADIAN VARVED CLAYS. *J. Soil Mechanics and Found. Div., ASCE* 88 (SM 4): 21-67. Aug. 1962.

Over considerable areas of North America, Scandinavia, and the USSR, there are clay deposits with a definite banded structure. Many of the banded deposits were formed in lake basins in which there were cyclic changes in temperature and sedimentation environment. Where these cyclic changes have produced a repetition of two distinct layers, one of which is generally coarser in grain size and lighter in color than the other, the deposits have normally been referred to as "varved clays."

Experience with varved clay at specific sites in Ontario was given. Brief case histories of some specific problems are included. The geology and geo-chronology of varved clays is open to considerable dispute and the literature on the detailed geotechnical properties of varved clays is extremely scanty. The authors concluded that:

1. In the design of structures on banded sediments, it was essential to separate the results of tests on bulk samples from detailed tests on specific layers. The mode of formation and stratification of banded sediments were so variable that the results of tests on bulk samples alone were extremely misleading.
2. Where the normally loaded sediments are thickly banded, the use of vane in-situ shear tests proved to be of considerable value in estimating the average shear strength of the deposits.
3. At certain locations, the $\phi = 0$ condition was applied successfully to the construction of embankments on normally loaded varved clay deposits.
4. The dissipation of pore pressures in banded deposits was generally quite rapid.
(The rate of dissipation of pore pressure may be a function not only of the thickness of the individual dark layers, but also of the length of the available continuous drainage paths in the more permeable light layers.)
5. The behavior of a limited number of friction piles in soft banded sediments indicated that the average undrained shear strength of the deposit as determined by vane tests may be used to estimate pile capacity.
6. Blasting was a feasible method of preventing entrapment of soft deposits below the embankment when constructing fills on soft, sensitive varied clays.

Yale U., New Haven, Conn.

Soil Chemistry and Minerology

Pratt, P. F., and Bair, F. L. CATION-EXCHANGES PROPERTIES OF SOME ACID SOILS OF CALIFORNIA. *Hilgardia* 33(13): 689-705. 1962.

Data on the soluble cations, exchangeable cations, cation-exchange capacity (CEC), pH-dependent cation-exchange capacity, and Na-Ca exchange equilibria of a number of acid soils of central and southern California are presented.

About half of the soils collected were of medium to high salinity. About 20 percent of the samples contained greater than 0.5 p.p.m. Al in the saturation extract and about 40 percent had greater than 10 p.p.m. Mn. At pH values of 5 and above there was very little exchange acidity extracted by $\frac{N}{10}$ KCl solution. Most of the acidity was pH-dependent and was extracted by a BaCl_2 solution buffered at pH 8.2. At pH values below 5, some soils contained considerable exchange acidity which was largely accounted for by measuring exchangeable Al. For most soils, the sum of the exchangeable cations, including the pH-dependent acidity, was equal to the CEC measured by Ba adsorption at pH 8.0.

All soils and clays contained a pH-dependent component of the CEC. The decrease in CEC with decrease in pH was found to be equal to the gain in pH-dependent acidity. The contribution of organic matter to the pH-dependent CEC was much greater than that of the clay. The CEC measured at the pH of the soil was a close estimate of the exchangeable cations plus exchange acidity extracted by KCl solution.

The ratio of adsorbed Na to adsorbed Ca increased with decrease in pH; as the CEC decreased with reduction in pH, the exchangeable Ca decreased more than exchangeable Na. The relative change in the ratio of adsorbed Na to Ca was predicted by an exchange equation based on the Poisson-Boltzmann differential equation. For a good agreement between the

exchange equation and the experimental data, the surface charge density had to be multiplied by a factor which was specific for each soil. These factors varied from 1.0 to 2.1.

Agr. Pub., Room 207 U. Hall, 2200 U. Ave., Berkeley 4, Calif.

Beetem, W. A., Janzer, V. J., and Wahlberg, J. S. USE OF CESIUM-137 IN THE DETERMINATION OF CATION EXCHANGE CAPACITY. Geol. Survey B. 1140-B, 8 pp. 1962.

Separate determinations of the exchange capacity of 5 American Petroleum Institute standard clay samples and 7 soil samples were made using cesium, ammonium, and manganese ions, respectively, to saturate the exchange sites of the samples.

The precision of the radiocesium method for determining cation exchange capacity was generally superior to both the ammonium and manganese methods. Because the cesium is determined instrumentally in a single analytical step, considerably less time is needed per analysis. This method can be used to determine cation exchange capacity of samples weighing as little as 30 mg. By adjusting the specific activity of the cesium ion, either very high or very low exchange capacities can be determined precisely.

For Sale by Supt. Doc., U.S. Govt. Printing Off., Washington, D.C. 20402.

Walker, J. M., and Barber, S. A. ABSORPTION ON POTASSIUM AND RUBIDIUM FROM THE SOIL BY CORN ROOTS. Plant and Soil 17: 243-259. 1962.

The mechanism of movement in and uptake of potassium from the soil by corn roots was investigated in the following experiments:

1. The influence of amount of exchangeable potassium and the percentage saturation of the exchange capacity with exchangeable potassium showed that when small amounts of uptake were occurring, i.e. during the first few days of corn, uptake was greater the higher the percentage potassium saturation. With more uptake, the level of exchangeable potassium determined availability.
2. The effect of the distribution of the soil containing exchangeable potassium within the pot showed that after 17 days of growth, the distribution had little influence on availability.
3. The variation of potassium uptake by corn from various parts of the pot was found to vary widely. Different segments of the soil in the pot were labelled with rubidium-86 so that the amount of rubidium uptake from each part of the pot could be studied. Rubidium uptake and reduction in potassium level were highly correlated indicating that, for this soil, rubidium-86 would be a suitable tracer for potassium.
4. Uptake by corn roots and movement of rubidium in the micro-region of soil surrounding these roots was studied using a new autoradiographic technique. This technique showed that corn roots absorb rubidium along their surface in amounts dependent upon plant development. The absorbing roots depleted the rubidium in the soil adjacent to their surfaces causing diffusion of rubidium to the root along a concentration gradient. The diffusion coefficient for rubidium in soil could be estimated from the increase in width of the depleted area with time.

The autoradiograph results explain the results of the first experiment. When the corn roots start growing and most of the absorption is through new roots, ease of replacement from the soil effects uptake. With time, most of the potassium or rubidium next to the root is absorbed and the diffusion gradient then governs the availability. Hence, the amount of

exchangeable potassium or rubidium present per volume of soil governs the amount of uptake.

The total amount absorbed per unit of soil in the third experiment depended on root density and time for absorption.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Misra, S. G., and Tiwari, R. C. STUDIES ON THE ADSORPTION AND RELEASE OF COPPER BY SOILS: I. EFFECT OF CATIONS. *Soil Sci. and Plant Nutr.* 8(3): 1-4. 1962.

The introduction of Na^+ and Ca^{++} ions greatly decreases the adsorption and subsequent release of Cu^{++} ions from dilute solutions of copper chloride in acid soils while they affect the adsorption of Cu^{++} ions in normal soil only to a little extent. The acid soil adsorbs far less Cu^{++} ions than normal soil. The adsorption of Cu^{++} ions, appears to obey the base exchange phenomenon, which depends on exchange capacity and pH of soils.

U. Allahabad, Allahabad, India.

Dutt, G. R. PREDICTION OF THE CONCENTRATION OF SOLUTES IN SOIL SOLUTIONS FOR SOIL SYSTEMS CONTAINING GYPSUM AND EXCHANGEABLE Ca AND Mg. *Soil Sci. Soc. Amer. Proc.* 26:341-343. 1962

The equilibrium relationships for the solubility of CaSO_4 in solution and the exchange of Ca^{++} and Mg^{++} between solution and the soil exchange complex may be used in conjunction with the Debye-Huckel theory to predict the equilibrium concentrations of the ions in solution and ions adsorbed by the exchanger when distilled water or a solution of Ca^{++} and/or Mg^{++} salts is used to wet a Ca-Mg-soil which contains an excess of CaSO_4 .

The equilibrium concentration of the solution and adsorbed ions were calculated for mixtures of CaSO_4 , Yolo soils containing different ratios of Ca^{++} to Mg^{++} , and distilled water and were compared with results of mixtures of CaSO_4 , Yolo soils containing different ratios of Ca^{++} to Mg^{++} , and 0.05 M MgCl_2 . The ionic concentrations of the equilibrium solutions were also determined experimentally for these same mixtures. The theoretical and measured concentrations of the ions in the equilibrium solution were compared.

U. Calif., Davis, Calif.

Lagerwerff, J. V., and Eagle, H. E. TRANSPIRATION RELATED TO ION UPTAKE BY BEANS FROM SALINE SUBSTRATES. *Soil Sci.* 93: 420-430. 1962.

Dwarf red kidney beans were grown in nine different culture solutions characterized by three levels (1.3, 2.3, and 3.3 atm.) for the osmotic pressure (OP) and three values (2.7, 19.3, and 51.2 mmol $\frac{1}{2}$ liter $^{-\frac{1}{2}}$) for the ion ratio $\text{Na}^+/\sqrt{\text{Ca}^{++} + \text{Mg}^{++}}$. Plants representative of each of the nine treatments were harvested after 10.8, 18.5, 24.2, and 28.8 days, at which time their water consumption was recorded. In conjunction with measurements of

both the total and the unshaded leaf-surface area, the rate of transpiration was measured in μl per cm^2 leaf surface per day. When expressed on the basis of the total leaf-surface area, the transpiration rate decreased with growth although the diffusion-pressure-deficit difference (DPDD) between plant sap and solution remained virtually constant for any one treatment. When correcting for changes in foliage geometry with growth by expressing the transpiration on the basis of the unshaded leaf-surface area, the transpiration rate appeared to be fairly independent of the growth stage of the plant and influenced mainly by the solution treatment. Related phenomena involve an increase of the Op of the sap of leaves and stems, of the moisture percentage of the leaves, and of the water requirement by the plant, under conditions of increasing ion ratio of the solution at any one osmotic concentration.

For each of the treatments and growth periods, the following characteristics were calculated: First, the ratio of the content of Na^+ , Ca^{++} , K^+ , or Cl^- of leaves, stems, or roots to the corresponding ion content of the entire plant, yielding relative ion contents. Second, the percent of the total amount of absorbed water that, if taken up as unchanged solution, would have satisfied the requirements of the plant for each treatment and growth period with respect to any one of the ion species mentioned. A high-rate accumulation of Na^+ and a low-rate accumulation of Ca^{++} were observed in the roots, and the reverse in the leaves. In addition, Na^+ and K^+ behaved antagonistically in roots and leaves. In spite of the prevalence of conditions that are considered to be conducive to such a relationship, no proportionality could be found between water and ion uptake. In many instances, ions were excluded from entry into the roots in a manner that suggests that this process is selective and active.

In regard to soils, the ion-concentration gradient between root-adjacent soil and surrounding soil is positively related to the rate of transpiration by the plant and the osmotic concentration of the growth medium, and negatively related to the rate of back-diffusion of excluded ions. Standards to evaluate the chemical condition of root-adjacent soil should take into account soil diffusivity for ions and water at given soil-moisture tensions.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif.

Wahlberg, J. S., and Fishman, M. J. ADSORPTION OF CESIUM ON CLAY MINERALS. Geol. Survey B. 1140-A, 30 pp. 1962.

A study was made of the exchange adsorption of cesium on the clay minerals kaolinite, halloysite, montmorillonite, and "illite." The amount of cesium adsorbed by clay minerals was measured in equilibrium solutions in which the cesium concentration ranged from 10^{-1} to 10^{-10} N, and either sodium, potassium, calcium, or magnesium ions were present in various concentrations. The results were used to calculate the distribution coefficients for the adsorption of cesium on clay minerals.

At very low cesium concentrations and for a constant concentration of the cation competing with cesium for adsorption sites, the distribution coefficients were found to be independent of the cesium concentration. The logarithm of this limiting value of the distribution coefficient was found to be a linear function of the logarithm of concentration of the competing cation. At higher cesium concentrations, the distribution coefficients were found to depend on both the cesium concentration and the nature and concentration of the competing cation.

For sale by Supt. Doc., U.S. Govt. Printing Off., Washington, D.C., 20402.

Weed, S. B., and Nelson, L. A. OCCURRENCE OF CHLORITE-LIKE INTERGRADE CLAY MINERALS IN COASTAL PLAIN, PIEDMONT, AND MOUNTAIN SOILS OF NORTH CAROLINA. Soil Sci. Soc. Amer, Proc. 26: 393-398. 1962.

Soils of the Coastal Plain, Piedmont, and Mountain regions of North Carolina were examined for the occurrence of chlorite-like intergrade clay minerals. The intergrade clay minerals were found to be very common constituents of soils examined, ranging in occurrence from trace to major amounts. Degree of interlayering, as estimated from response of clays to acid NH_4F treatment, was related to position of the clay in the profile, usually decreasing with depth. The amount of 3-layer clay, as estimated by X-ray diffraction, was greatest in the surface horizons and decreased with depth. For soils formed on similar parent material, 3-layer clays from well-drained, highly oxidized soils were usually more difficult to collapse than those from less oxidized soils. Chemical and mineralogical studies suggest that the intergrade clay minerals originated from mica precursors.

The author indicated that: (1) Chlorite-like intergrade clay minerals are important constituents of many soils of the Coastal Plain, Piedmont, and Mountain areas of North Carolina, frequently dominating the clay fraction; (2) X-ray diffraction patterns suggested a maximum of the intergrade mineral relative to kaolinite in the clay fraction of the surface horizon of each soil profile studied and a decrease in concentration with depth; (3) the degree of interlayering, as measured by attempts to remove interlayer material, is variable and apparently dependent on position of the clay mineral in the profile; (4) removal of interlayer material results in a marked increase in CEC, indicating that exchange sites in the normal clay mineral are blocked or occupied by difficulty removable ions, and (5) electron micrographs indicate a mica-like morphology for the intergrade clay mineral, suggesting a mica precursor.

Agr. Expt. Sta., N.C. State Col., Raleigh, N.C.

Nakayama, F. S., and Scott, A. D. GAS SORPTION BY SOILS AND CLAY MINERALS: I. SOLUBILITY OF OXYGEN IN MOIST MINERALS. Soil Sci. 94: 106-110. 1962.

The amount of oxygen sorbed by soils and clay minerals was determined with moist samples that were progressively dried to different moisture levels. In every instance the sorption values increased when the moisture content was reduced beyond a certain level. Samples with more than this amount of moisture sorbed the same amount of oxygen as was calculated to be soluble in an equivalent amount of pure water. Thus, there was no evidence of a salting-out effect in these materials. All the water that was added to samples with expanding lattice minerals, however, was not always accessible for the dissolution of the gas.

SWCRD, ARS, USDA, Tempe, Ariz.

Wear, J. I., and Patterson, R. M. EFFECT OF SOIL pH AND TEXTURE ON THE AVAILABILITY OF WATER-SOLUBLE BORON IN THE SOIL. Soil Sci. Soc. Amer. Proc. 26: 344-346. 1962.

A greenhouse study was conducted with alfalfa to determine the relationship between water-soluble B in the soil and plant uptake as affected by soil texture and pH. Soils used were Norfolk sl, Hartsells fsl, and Decatur sil representing coarse-, medium-, and fine-textured soils. Treatments included five rates of B at three pH levels. Yields and B content

of plants were measured. After the plants were harvested, soils were analyzed for water-soluble B and pH. Results showed that alfalfa grown on the coarse-textured soil had the highest uptake of B per unit of water-soluble B in the soil and the plants from the fine-textured soil had the least. The medium-textured soil was intermediate. As the acidity decreased from a pH value of 5 to 7, less B was available at any level of water-soluble B in all three soil types. These results indicate that texture and pH must be considered when water-soluble B is used as a measure of availability to plants.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

Kee, N. S., and Bloomfield, C. THE EFFECT OF FLOODING AND AERATION ON THE MOBILITY OF CERTAIN TRACE ELEMENTS IN SOILS. *Plant and Soil* 16: 108-135. 1962.

Iron, cobalt, nickel, zinc, lead, vanadium, and molybdenum were mobilized when soils were flooded and incubated anaerobically with plant material. Chromite was unreactive under these conditions, but chromium was mobilized in a soil of normal composition.

Mobilization of molybdenum occurred in conditions of increasing acidity, although the evidence indicates that this element remained in an anionic form during incubation.

Copper behaved in a more complicated fashion. In a well-drained soil, copper was mobilized when the soil was incubated with the sole addition of water, but in the presence of added plant material the extractable copper disappeared rapidly, presumably as the result of sorption on plant fibre. In a poorly drained soil of high organic content, the water-soluble copper formed in the early stages of incubation also disappeared, but in this case sorption on plant fibre did not appear to be responsible.

Much iron was immobilized when the incubated soils were aerated, and although drying further decreased the amount of iron extracted, the net result of flooding and re-drying was to increase the extractability of iron and the trace metals.

The total amounts of extractable manganese, cobalt, and zinc were hardly affected by reoxidation. Lead was immobilized to a certain extent with respect to water and neutral ammonium acetate, probably because lead carbonate was formed.

In general, reoxidation decreased the amount of material extractable by water, but this decrease was partly offset by corresponding increases in the acetate fractions.

Less molybdenum was immobilized on aeration than would be expected in an inorganic system; coprecipitation with ferric oxide may have been inhibited by the organic matter.

In one instance, sorption of nickel on plant fiber caused less nickel to be mobilized when the soil was incubated with whole plant material instead of a plant extract, but the sorbed nickel was liberated on aeration. In a poorly drained soil of high organic content, nickel, like copper, did not appear to be affected by the presence of plant fiber.

Rothamsted Expt. Sta., Harpenden, Herts, England.

Smith, P. F., Rasmussen, G. K., and Hrniciar, G. LEACHING STUDIES WITH METAL SULFATES IN LIGHT SANDY CITRUS SOIL IN FLORIDA. *Soil Sci.* 94: 235-237. 1962.

Columns of topsoil and subsoil of Lakeland fs were leached to determine the mobility of Cu, Zn, and Mn under both high- and low-acid conditions. Cu, Zn, and Mn were added as sulfate solutions. Thirty fractions of water were run through the columns during a 10-week period.

Both pH and organic matter content affected metal mobility. The topsoil was much more retentive than the subsoil, and at the same pH the difference was about four-fold.

The order of mobility was the same in all cases tested and was $Mn > Zn > Cu$, with Zn about halfway between Cu and Mn.

The relatively weak retention of metals by the organic-free subsoil offers an explanation of the heavy loss when surface-applied metals are plowed under.

U.S. Hort. Sta., Orlando, Fla.

Shaw, K. LOSS OF MINERAL NITROGEN FROM SOIL. J. Agr. Sci. 58: 145-151. 1962.

The pattern of downward movement of nitrate in light soil is different from that in heavy clay soil.

In light sandy soils, where vertical structural fissures are absent, nitrate becomes distributed down the profile on leaching.

In heavy soils, which are well fissured and possess a gleyed horizon of partially decomposed plant debris at cultivation depth, most of the nitrate disappears from the profile after removal, by leaching or denitrification, from the cultivation layer.

There is little difference in the amount of rain required to remove nitrate from the surface layers of light or heavy soil.

Heavy and continuous rain is required to remove nitrate completely from either light or heavy soils.

Nitrification of ammonium sulphate is more rapid summer than winter, but nitrification does proceed slowly during winter.

Ammonium nitrogen is not leached from the surface layer of either light or heavy soil.

Natl. Agr. Advisory Serv., Newcastle upon Tyne, England.

Harward, M. E., Chao, T. T., and Fang, S. C. THE SULFUR STATUS AND SULFUR SUPPLYING POWER OF OREGON SOILS. Agron. J. 54: 101-106. 1962.

The sulfur status and sulfur supplying power as related to the growth of alfalfa on 16 soils were investigated by chemical and biological procedures. Levels of organic sulfur were found to range from 77 to 765 p.p.m. These levels were highly correlated with organic carbon and total N. In general, soils with high levels of organic matter had higher sulfur "A" values and higher levels of extractable sulfate plus sulfate release. The amounts of extractable sulfate plus sulfate release were small in comparison with levels of total organic sulfur.

Yield responses were obtained on 11 of the 16 soils. Organic sulfur alone was not closely related to yield of alfalfa. In general, soils that exhibited no yield response had higher sulfur "A" values and higher levels of extractable sulfate plus sulfate release. Correlation coefficients of yield with soil and plant analyses were in the decreasing order: sulfur "A" values, percent S in the plant, and extractable sulfate plus sulfate release. The sulfur "A" values were also linearly related to content of S in alfalfa and amounts of extractable sulfate plus sulfate release for the soils.

A sulfur "A" value of about 20 lbs. per acre and a level of about 0.22% S in the plant were taken as "critical" levels for the conditions under which the studies were conducted.

The data indicated a close relationship between sulfur and nitrogen contents of alfalfa. Part of the effects of sulfur applications may be indirect and related to nitrogen relationships of the legume.

Oreg. Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg.

Williams, C. H., and Steinbergs, A. THE EVALUATION OF PLANT-AVAILABLE SULPHUR IN SOILS: I. THE CHEMICAL NATURE OF SULPHATE IN SOME AUSTRALIAN SOILS. *Plant and Soil* 17: 279-294. 1962.

Examination of a range of naturally occurring calcium carbonates and calcareous soils showed that insoluble sulphate associated with calcium carbonate may comprise an important fraction of soil sulphur. One soil contained as much as 93 percent of its sulphur in this form. It seems likely that this sulphate occurs as a co-precipitated or co-crystallized impurity in the calcium carbonate.

Most surface soils had only low capacity to adsorb sulphate and contained only small amounts of sulphur in this form. Two acid surface soils and many acid subsoils, however, adsorbed sulphate quite strongly and in some acid subsoil clays adsorbed sulphate made up an important fractions of the total sulphur.

Sulphate adsorption was found to be negligible above pH 6.5 and adsorbed sulphate may be determined by aqueous extraction after increasing the pH above this value by addition of solid calcium carbonate. Adsorption of sulphate during acid extraction of soils can lead to low values in the determination of acid-soluble sulphates. Sulphate so adsorbed can be determined by a second extraction with water after the addition of solid calcium carbonate to increase the pH to a value greater than 6.5.

Div. Plant Indus., Commonwealth Sci. and Indus. Res. Organ., Canberra, Australia.

Gasser, J. K. R. EFFECTS OF LONG-CONTINUED TREATMENT ON THE MINERAL NITROGEN CONTENT AND MINERALISABLE NITROGEN OF SOIL FROM SELECTED PLOTS OF THE BROADBALK EXPERIMENT ON CONTINUOUS WHEAT, ROTHAMSTED. *Plant and Soil*. 17: 209-220. 1962.

The changes in the ammonium-N and nitrate-N contents of bare fallow and soil under the first and third crops of winter wheat after fallow were followed on plots of Broadbalk Field, Rothamsted, which have received for each crop 14 tons farmyard manure (FYM) per acre, 'complete minerals' (P, K, Na, Mg), or 'complete minerals' + nitrogen fertilizers.

More mineral N was produced during fallow on the plot receiving FYM than on the other plots. Soil under wheat also contained more mineral N on the FYM plots than elsewhere. Nitrogen fertilizers applied in the spring temporarily increased the mineral-N content of the soil, but were rapidly removed by the crop. Ammonium sulphate applied in the autumn was lost from the surface soil by the following March through nitrification and leaching.

Twice as much mineral-N was produced when soil from the FYM plot was incubated as when soils from other plots were similarly treated. Nitrate formed during fallow was leached into the subsoil during the autumn and winter, and recovered by the wheat during the following spring and summer. Its existence is not detected by sampling the surface soil, nor by an incubation test. This source of nitrogen complicates the use of laboratory measurements to assess the fertilizer nitrogen required by winter wheat. Since the crop removed mineral N from the surface soil by March, estimation of the amount then present was also of no value for making fertilizer recommendations.

Rothamsted Expt. Sta., Harpenden, Herts, England.

Motomura, S. THE RELATIONSHIP BETWEEN FERROUS IRON FORMATION AND NITROGEN METABOLISM IN SOIL. *Soil Sci. and Plant Nutr.* 8: 177-185. 1962.

The total amounts of ferrous iron in soil, which is thought at present to indicate only the index of the intensity or degree of soil gleization, has been considerably affected by the ad-

dition of inorganic nitrogen compounds, depending on their forms and their concentrations.

The addition of nitrate salts suppressed the ferrous iron formation with their increasing concentration. Oxygen of nitrates offered a rich oxygen source for soil microbes under the condition of a limited oxygen supply. Anaerobes utilized this oxygen in preference to oxygen of iron oxides which existed in the largest quantities in soil. Accordingly, the formation of ferrous iron was considerably hindered by the addition of nitrates.

By the increasing exhaustion of oxygen due to the glucose treatment, ferrous iron formation occurred in the case of nitrate application.

The application of ammonium salts led to an increase of the formation of ferrous iron, independent on their forms and their concentrations, except the extreme concentrations, as the results of increasing biological activities due to the utilization of the added ammonium salts.

Natl. Inst. Agr. Sci., Tokyo, Japan.

Barber, T. E., and Matthews, B. C. RELEASE OF NON-EXCHANGEABLE SOIL POTASSIUM BY RESIN-EQUILIBRATION AND ITS SIGNIFICANCE FOR CROP GROWTH. *Canad. J. Soil Sci.* 42: 266-272. 1962.

The non-exchangeable potassium released by soil after equilibration with cation-exchange resin was determined by extraction of the mixture with neutral ammonium acetate at room temperature and compared with a similar extraction in the absence of resin. The difference obtained following a 2-day equilibration period was called moderately available potassium.

Simple linear regression of yield on exchangeable potassium or exchangeable plus moderately available potassium accounted for only 16 and 27 percent, respectively, of the variability in yield response of corn, wheat, oats, and potatoes to potassium fertilizer in the field. Multiple linear regression of yield on exchangeable and moderately available potassium accounted for an average of 37 percent of the variation in crop response; but a multiple quadratic regression of Log (100-percent yield) on exchangeable and moderately available potassium accounted for an average of 56 percent of the variability in Log (100-percent yield). Multiple quadratic regression of absolute yield or percent yield on exchangeable and moderately available potassium accounted for 46 and 50 percent, respectively, of the variability in crop response to potassium fertilizer.

Ontario Agr. Col., Guelph, Ontario, Canada.

Mackenzie, A. F., and Dawson, J. E. A STUDY OF ORGANIC SOIL HORIZONS USING ELECTROPHORETIC TECHNIQUES. *J. Soil Sci.* 13: 160-166. 1962.

Saturated sodium-phyrophosphate extracts were obtained from samples of Sphagnum-moss peat, sedimentary peat, fibrous peat, disintegrated peat, and muck and were subjected to electrophoretic separation and analysed for organic matter, polysaccharides, and colored material. The resulting patterns indicated a marked difference between the muck samples and the peat samples. The high exchange-capacity values obtained for muck samples were associated with the amount of highly charged material rather than with an increase in the charge density of this material. The muck and the fibrous-peat samples appeared to be end members in a disintegration and oxidation sequence involving many intermediate stages.

Ontario Agr. Col., Guelph, Ontario, Canada.

Golden, L. E. EFFECT OF TEMPERATURE OF EXTRACTANT ON P, K, Ca, AND Mg REMOVED FROM DIFFERENT SOIL TYPES. *Soil Sci.* 93: 154-160. 1962.

A laboratory study was made of the effect of temperature of extracting solutions of 0.1 N HCl + 0.03 N NH_4F on P removed, and of 0.1 N HCl on K, Ca, and Mg removed, from the horizons of several alluvial and terrace soils of Louisiana.

Curves constructed from P extraction data from all soil horizons of the Mhoon and Olivier soils and from the 4- to 8-inch depth of the Yahola soil, using a 1:20 soil: extractant ratio, had highly significant positive slopes. Data from the 14- to 18-inch depth of the Yahola soil using a 1:20 soil: extractant ratio showed no significant effect from variation in temperature of extractant, but the curve constructed from data from the Yahola soil at the 24- to 28-inch depth had a highly significant negative slope. When a soil: extractant ratio of 1:40 was used with samples from the 14- to 18-inch and 24- to 28-inch depths of the Yahola soil, curves were obtained with highly significant positive slopes.

Curves constructed from K extraction data from all samples studied had highly significant positive slopes.

Ca extracted from the different soils was associated with temperature of extractant in some cases positively, in others negatively, and in still others not at all. Mg extracted from Olivier soil was not associated with temperature of extractant, but in all other cases it was positively associated with temperature of extractant.

Results show the need for standard conditions and procedures in the soil-testing laboratory. Control of temperature at which extractions are made is highly desirable if reproducible work is to be accomplished. Moisture content of soil samples at the time of extraction affected soil-test values. Soil samples should be air-dried at a constant temperature for a definite time under conditions of constant humidity.

La. Agr. Expt. Sta., University Station, La.

Adams, F., and Evans, C. E. A RAPID METHOD FOR MEASURING LIME REQUIREMENT OF RED-YELLOW PODZOLIC SOILS. *Soil Sci. Soc. Amer. Proc.* 26: 355-357. 1962.

The exchangeable acidity determined by neutral 1 N NH_4OAc was compared to that measured in a buffered solution on 348 soil samples from profiles of Red-Yellow Podzolic soils in Alabama. The soil pH values ranged from 4.1 to 6.5 and cation-exchange capacities from 0.8 to 13.0 me. per 100 g. The methods measured comparable amounts of acidity. An equation was calculated by the method of least squares for the relationship between soil pH and percent base unsaturation for all samples. The amount of CaCO_3 needed to bring soil pH to desired level was calculated by estimating percent base unsaturation from soil pH values in water and by measuring exchangeable acidity of soil by pH values in a buffered solution. The validity of this procedure was tested by incubating soils with increments of $\text{Ca}(\text{OH})_2$ and measuring the change in soil pH.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

Breland, H. L., and Sierra, F. A. A COMPARISON OF THE AMOUNTS OF PHOSPHORUS REMOVED FROM DIFFERENT SOILS BY VARIOUS EXTRACTANTS. *Soil Sci. Soc. Amer. Proc.* 26: 348-350. 1962.

The relative effects of 8 extractants on the removal of phosphorus from 7 major soil types of Florida were studied. HCl plus NH_4F and HCl plus H_2SO_4 solutions extracted more

phosphorus than the other extractants. The amount of phosphorus extracted by any of the extractants apparently depended, to a large extent, on the kind and amount of phosphorus compounds present in the soil as well as other factors. Soils high in phosphorus required a longer extraction period to reach equilibrium than those low in phosphorus. Increasing the length of stroke of the shaking machine from $1\frac{1}{2}$ to 3 inches did not significantly affect the amount of phosphorus removed from the soils. In general, an extraction time of 10 to 15 minutes was sufficient for the extraction of soil phosphorus.

Fla. Agr. Expt. Sta., Gainesville, Fla.

Bingham, F. T. CHEMICAL SOIL TESTS FOR AVAILABLE PHOSPHORUS. *Soil Sci.* 94: 87-95. 1962.

Effective soil testing for phosphorus available to plants is possible within reasonable limits, provided suitable techniques are used both in field sampling and in the chemical laboratory. Demonstrations under field conditions of the phosphorus need of a crop are without a question the final evaluation. For a great many soils, a provisional appraisal of this need can be obtained by a chemical examination of the soil concerned. In many instances, tree crops for example, tissue analysis is more satisfactory than soil testing. In new areas, however, the soil test can be of real value, and where management practice changes, soil test can be of real value, and where management practice changes, soil tests can, in addition, measure any residual effect of previously applied phosphorus.

In general, acid soils probably can be analyzed by a variety of techniques with equal or near equal results, provided standards are available. The data in table form provide tentative standards; these standards could be refined further for a specific crop and region. Neutral and alkaline soils could perhaps be better appraised with the milder extractants. Considerable background data are accumulating on the NaHCO_3 technique.

A reliable soil test for phosphorus should not be modified to include other constituents (exchangeable bases) unless it is clearly shown that the precision of the phosphorus appraisal has not been reduced.

U. Calif. Citrus Res. Cent., Agr. Expt. Sta., Riverside, Calif.

Hance, R. J., and Anderson, G. A COMPARATIVE STUDY OF METHODS OF ESTIMATING SOIL ORGANIC PHOSPHATE. *J. Soil Sci.* 13: 231-240. 1962.

Organic phosphate values for 34 Scottish surface soils were obtained by an ignition method, by two standard extraction methods, and by a modified extraction procedure designed to decrease hydrolysis of acid labile phosphate esters.

The extraction method of Saunders and Williams tended to be superior to that of Mehta *et al.* with acid soils, and inferior with calcareous soils, although in many cases the values obtained are similar. A modification of the Mehta method, involving extraction of the soil with alkali before as well as after acid treatment, caused less hydrolysis than the standard method with acid soils, and gave the highest average values for the soils as a whole. Attempts to increase the efficiency of the standard extraction procedures by varying the nature of the acid pre-treatments were unsuccessful.

Ignition values were usually greater than the highest extraction values, but in more than half the soils the differences were small and unimportant. Since the ignition procedure is

rapid and easy to perform, it is considered to be the most useful for the general analysis of Scottish soils.

Macaulay Inst. Soil Res., Aberdeen, Scotland.

Hinman, W. C., Beaton, J. D., and Read, D. W. L. SOME EFFECTS OF MOISTURE AND TEMPERATURE ON TRANSFORMATION OF MONOCALCIUM PHOSPHATE IN SOIL. *Canad. J. Soil Sci.* 42: 229-239. 1962.

Pre-weighed monocalcium phosphate pellets, containing about 51 milligrams of P, were placed in 200 grams of soil and stored for 2 weeks at four moisture tensions and three temperatures. Pellet residues were then removed and the amount of phosphorus remaining was determined. Small cores containing pellet residues and the surrounding soil contacted by fertilizer solution were removed for determination of water-soluble and total inorganic P. Phosphate phases present at the granule sites and the surrounding soil were identified by their optical properties.

The mean amount of phosphorus remaining at the granule sites was 20.2 percent. Although both moisture tension and temperature significantly affected the quantity of phosphorus retained, no consistent trend was apparent. Residues remaining at the site of application were found to be mixtures of anhydrous and dihydrated dicalcium phosphate, with the latter predominating. Moisture tension and temperature did not greatly alter the proportion of the two phases.

Periodic precipitates or Liesegang rings of dicalcium phosphate were formed in the soil surrounding monocalcium phosphate pellets. Dicalcium phosphate dihydrate was the predominant phase. The proportion of dihydrated to anhydrous dicalcium phosphate increased as the temperature decreased and as the moisture tension increased.

Water-soluble P increased significantly with increased moisture tension and was significantly greater at 5°C. than at either 16°C. or 27°C. The mean of all treatments was 5.6 percent. Increased amounts of dicalcium phosphate dihydrate in the surrounding soil seemed to be responsible for the increase in water solubility.

Between 89.5 and 99.2 percent of the added phosphorus was recovered in the water and acid extracts of soil cores containing about 1.4 cm. of soil.

Expt. Farm, Res. Br., Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

Moore, A. W., and Rhoades, H. F. PHOSPHORUS NUTRITION IN TWO NEBRASKAN WET MEADOW SOILS. *Canad. J. Soil Sci.* 42: 289-295. 1962.

Two wet meadow soils of the Loup series in the Nebraska Sandhills were selected for study because vegetation growing on Soil 1 showed a marked response to phosphate fertilizer whereas that on Soil 2 showed little or no response to phosphate fertilizer.

Curves for yields of dry matter indicated that available phosphorus (Mitscherlich "b" value) was much lower in Soil 1 (10 pounds phosphorus per acre) than in Soil 2 (35 pounds phosphorus or more per acre).

Using P-32 labelled triple superphosphate, it was shown that during the growing season of 1955 the meadow vegetation on Soil 1 derived about twice as much phosphorus from fertilizer as from the soil, while the vegetation on Soil 2 obtained about equal quantities of phosphorus from soil and fertilizer sources.

The groundwater from Site 2 contained about three times as much phosphorus as that from Site 1 (0.41 p.p.m. and 0.12 p.p.m. P, respectively).

A laboratory study of the mineralization of soil organic phosphorus indicated that in Soil 2 microbiological action released inorganic phosphorus whereas in Soil 1 inorganic phosphorus was assimilated.

Differences in phosphorus content of groundwater and in microbial activity were probably responsible for differential responses to phosphorus fertilization obtained in the field.

Jr. Author, U. Nebr., Lincoln, Nebr.

Basak, M. N., and Bhattacharya, R. PHOSPHATE TRANSFORMATIONS IN RICE SOIL. *Soil Sci.* 94: 258-262. 1962.

Transformations of different soil phosphorus fractions in rice fields during the cropping season and intervening fallow period were studied to determine the reasons behind the inconsistency in response of phosphate fertilizers on rice cultivation in India.

Iron and aluminum phosphates, which constituted about 46.6 percent of the total P_2O_5 content in puddled soils at planting time, decreased from 847 to 424 pounds per acre (2 million pounds) during the course of crop life. Organic phosphorus, which formed about 41.6 percent of the total P_2O_5 content in puddled soils, also decreased more or less in a similar manner from 756 to 336 pounds per acre during the same period. Both of these fractions showed increases during the subsequent cultivation season to regain their original values by the next planting time.

Available phosphoric acid showed about 64 percent increase from planting to tillering stage, maintained its high level through preflowering time, and gradually dropped to its original level at harvesting. There was practically no change in the value of this fraction during the fallow period.

Total P_2O_5 content also showed changes from 1,818 to 1,649 pounds per acre from planting to tillering time, and to 1,603 pounds towards preflowering time. The original content was almost restored by planting time the following season.

The agricultural implications of these dynamic phosphate transformations in rice soils were discussed.

Kearney Found. *Soil Sci.*, U. Calif., Berkeley, Calif.

Harris, C. I., and Warren, G. F. DETERMINATION OF PHOSPHORUS FIXATION CAPACITY IN ORGANIC SOIL. *Soil Sci. Soc. Amer. Proc.* 26: 381-383. 1962.

In a study of 15 organic soils, the reduction in phosphorus concentration in aqueous solutions shaken with the soils gave a good indication of their phosphorus fixation capacities. An equally good indicator in soils that had prior phosphorus fertilization was the level of water-extractable phosphorus. Total iron, aluminum, calcium, and phosphorus content of the soils did not relate significantly to phosphorus fixation capacity.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Soil Biology

Allison, F. E., and Murphy, R. M. COMPARATIVE RATES OF DECOMPOSITION IN SOIL OF WOOD AND BARK PARTICLES OF SEVERAL HARDWOOD SPECIES. *Soil Sci. Soc. Amer. Proc.* 26: 463-466. 1962.

The decomposition rates of the finely ground woods and barks of 9 species of hardwoods were determined in the laboratory at two nitrogen levels. Carbon dioxide was measured at frequent intervals during periods varying from 72 to 580 days. The following species were studied: black oak, white oak, red oak, post oak, hickory, red gum, yellow poplar, chestnut, and black walnut. During the first 60 days an average of 30.3 percent of the wood carbon was released as CO₂ in the absence of fertilizer nitrogen, and 45.1 percent was released in its presence; the corresponding values for the barks were 22.4 and 24.5 percent. The variations in the rates of CO₂ release from the woods were not great, but hickory and black walnut barks decomposed much slower than the other barks. The hardwoods were attacked much more readily than most of the softwoods used in an earlier study, and consequently more nitrogen was required by the microorganisms that decomposed them. There were no indications that any of these wood products was toxic to the decay organisms.

SWCRD, ARS, USDA, Beltsville, Md.

Mela, P. M. FIXATION OF AMMONIUM BY CLAY MINERALS IN RELATION TO SOME PROBABLE EFFECTS ON THE VEGETATIVE DEVELOPMENT OF PLANTS. *Soil Sci.* 93: 189-194. 1962.

The fixation of ammonium by clays changes with changes in interlayer space and structure, in intermolecular attraction, and in elasticity of the clay mineral, all of which increase with increases in temperature and moisture.

The subsoil fixes much more ammonium than the top soil, but top soil increases its fixation when subjected to washings.

When 20 me. ammonium was added per 100 g. soil to the simple montmorillonite of Palencia (Spain), montmorillonite fixed 5.1 me. air-dried and half-moistened and illite a tenth part. Heating to 100°C., and especially if the sample was treated with Na₂CO₃, increased fixation. At 100°C. kaolinite fixed 0.3 me. and halloysite 1.2 me.

In natural soil, fixation increases when its percentage of montmorillonite increases; the percentage of fixed ammonium is in inverse ratio to the added ammonium.

Ammonium fixation can be agriculturally significant in wet and hot climates, in sandy soils, and in long-cycle crops.

Ingeniero Agribromo, Zaragoza, Spain.

Weber, D. F., and Gainey, P. L. RELATIVE SENSITIVITY OF NITRIFYING ORGANISMS TO HYDROGEN IONS IN SOILS AND IN SOLUTIONS. *Soil Sci.* 94: 138-145. Sept. 1962.

Sensitivity studies of nitrifying bacteria to H⁺ were conducted under three radically different conditions in soil, soil-perfusion, and liquid cultures.

Four highly acid soils of varying buffer capacities and total organic nitrogen contents were employed as culture media and/or sources of nitrifying inocula. The soils were employed as media without alteration and with supplemental nitrogen in the form of (NH₄)₂SO₄, using the conventional beaker technique. A dilute ammonium sulfate solution was drawn through the soil by the soil-perfusion technique.

The accumulation of NO_3^- at various pH levels under the various experimental conditions was employed as the criterion of the sensitivity of the nitrifying bacteria to H^+ concentration.

Significant to large accumulations of NO_3^- were recorded in all four of the untreated, highly acid soils. An increase in the hydrogen ion concentration, until a pH of approximately 4.0 was reached, paralleled the accumulation of NO_3^- in both poorly and highly buffered soils.

Both the rate and total accumulation of NO_3^- in the untreated soils were more closely associated with the total organic nitrogen content of the soil than with its H^+ concentration, at least until the pH dropped to 4.0 or slightly below. Lowest pH values recorded for the four soils were Cape Fear 1, 4.0; Roanoke sil, 3.9; Geary sil, 4.0; and Wickham sil, 4.1. If these low pH values resulted from nitrous and/or nitric acid formation, it follows that nitrification must have continued until these low pH values were reached.

Marked accumulation of NO_3^- was recorded in the untreated soils after pH levels of 4.0, 4.1, and 4.1 were recorded, respectively, for the Cape Fear 1, Roanoke sil, and Geary sil. Similar results were recorded in soil perfusion experiments with Cape Fear 1, Roanoke sil, and Wickham sil.

The nitrifying bacteria in North Carolina coastal plain soils appeared to be rather sensitive to either the NH_4^+ or the SO_4^{--} ions, since the equivalent of only 50 p.p.m. nitrogen in the form of $(\text{NH}_4)_2\text{SO}_4$ per 100 g. soil retarded or completely inhibited nitrification.

The maximum H^+ concentration reached was approximately the same for all four soils in both the soil-culture and soil-perfusion experiments, that is pH 4.0 or slightly below.

No accumulation of NO_3^- was recorded in a liquid medium buffered at pH levels below approximately 6.0.

SWCRD, ARS, USDA, Prosser, Wash.

Turner, G. O., Warren, L. E., and Andriessen, F. G. EFFECT OF 2-CHLORO-6-(TRICHLOROMETHYL)PYRIDINE ON THE NITRIFICATION OF AMMONIUM FERTILIZERS IN FIELD SOILS. *Soil Sci.* 94: 270-273. 1962.

Control of nitrification of $(\text{NH}_4)_2\text{SO}_4$, NH_4NO_3 , ammonium phosphate sulfate (16-20-0), aqua ammonia, and anhydrous ammonia treated with 2-chloro-6(trichloromethyl) pyridine and applied to several field soils was studied.

The chemical gave partial control of nitrification of all of the fertilizers at rates varying from 0.5 to 2 percent of the ammonium nitrogen in the fertilizer. A higher level of recovery usually was obtained with increasing rates of chemical.

Dow Chemical Co., Seal Beach, Calif.

Okuda, A., Yamaguchi, M., and Nioh, I. NITROGEN-FIXING MICROORGANISMS IN PADDY SOILS: X. EFFECT OF MOLYBDENUM ON THE GROWTH AND THE NITROGEN ASSIMILATION OF TOLYPOTHRIX TENUIS. *Soil Sci. and Plant Nutr.* 8(3): 35-39. 1962.

A nitrogen-fixing blue-green algae, Tolypothrix tenuis, was grown in absence and in presence of combined nitrogen sources including potassium nitrate, ammonium sulfate, urea, and monosodiumglytamate, and its growth responses for molybdenum were investigated.

In the absence of combined nitrogen, i.e., when molecular nitrogen was utilized as its sole nitrogen source, the optimal concentration of molybdenum was 10^{-2} p.p.m. When nitrate was fed, the optimal concentration was also 10^{-2} p.p.m.

In the presence of other three nitrogenous compounds of reducing form, no growth responses of the algae for molybdenum were shown.

Kyoto U., Kyoto, Japan.

Soil-Plant-Animal Relationships

Karim, A. Q. M. B., and Vlamis, J. MICRONUTRIENT DEFICIENCY SYMPTOMS OF RICE GROWN IN NUTRIENT CULTURE SOLUTIONS. *Plant and Soil*. 16: 347-360. 1962.

Rice plants were grown in a series of nutrient solutions lacking in individual micro-nutrients. Precautions were taken to minimize contamination from reagents, distilled water, and the environment. The deficiency symptoms of manganese, zinc, boron, and chlorine on rice were distinctly shown. The symptoms for copper and molybdenum deficiency appeared late and were not as severe. Nevertheless, it adversely affected the production of seed. The lack of copper delayed the ripening of the grain, and the seed produced by copper- and molybdenum-deficient plants failed to germinate.

The deficiency symptoms for zinc occurred in the old leaves, while those for boron and chlorine appeared on the youngest leaves. The symptoms for manganese deficiency were most severe in the younger leaves next to the emerging shoot. Molybdenum-deficiency symptoms first developed on the older leaves but in the case of copper the newly emerging leaves showed the most severe symptoms.

The lack of manganese and zinc had a marked effect on the root development of rice. Deficiency symptoms for manganese, zinc, boron, and chlorine were so severe that the plants failed to mature. The symptoms for molybdenum and copper deficiency were not as pronounced, indicating their very small requirement by rice and the difficulty of providing and maintaining a purified medium. Plants grown in cultures lacking zinc, manganese, boron, and chlorine failed to produce seed, while the seed produced by copper- and molybdenum-deficient plants failed to germinate. Copper, chlorine, and molybdenum content of shoots and seeds are reported.

U. Calif., Davis, Calif.

Weber, J. B., and Caldwell, A. C. SOYBEAN CHLOROSIS FROM HEAVY FERTILIZATION. *Agron. J.* 54: 425-427. 1962.

Heavy applications of concentrated superphosphate alone and in combination with KCl resulted in chlorotic plants. There was evidence that K was limiting on plants receiving high rates of P and that Mn was limiting on plants receiving high rates of both P and K. Applications of Mn chelates gave a slight increase in yield on plots that received high rates of P and K and a large decrease on plots that received P only.

Minn. Agr. Expt. Sta., U. Minn., St. Paul, Minn.

Jackson, W. A., and Evans, H. J. EFFECT OF Ca SUPPLY ON THE DEVELOPMENT AND COMPOSITION OF SOYBEAN SEEDLINGS. *Soil Sci.* 94: 180-186. 1962.

In the absence of added Ca in sand culture experiments, soybean seedlings rapidly developed a necrotic symptom of the primary leaves. Affected tissue contained from 0.08 to

0.12 me. Ca per g. In two of the experiments, no significant reduction in root growth occurred, whereas in each experiment top growth was significantly reduced. Increasing the Ca supply eliminated the appearance of the symptoms on the primary leaves and restricted Mg accumulation in the tops, but it did not reduce the accumulation of Mg by the roots. Increasing Ca supply appeared to have multiple effects on K accumulation in the tops, small additions tending to increase K accumulation and larger amounts to reduce it.

N.C. State Col., Raleigh, N.C.

Vlams, J., and Williams, D. E. LIMING REDUCES ALUMINUM AND MANGANESE TOXICITY IN ACID SOILS. Calif. Agr. 16(9): 6-7. 1962.

Studies of the interaction of nutrients and toxic substances in soils of different acidity levels have shown that liming will raise the pH, increase the calcium supply, and lower toxic levels of manganese and aluminum to tolerable amounts. When the pH of soil reached 5.5, water soluble manganese was increased as compared with more alkaline soils. As the pH approached 5.0, aluminum toxicity appeared. The amount of lime added should be regulated since an excess can induce deficiencies of iron, magnesium, and other nutrients.

The results of a chemical analysis of two solutions displaced from samples of an acid soil are shown in the table. The first sample was left untreated; the second was limed, and allowed in incubate for 48 hours before the solution was made. The effect of liming was to raise the pH, increase the calcium supply, and lower the manganese and aluminum. The solutions were further analyzed for nitrogen, phosphorus, potash, sulfur, and magnesium. The amounts of iron found were not unusually high in either solution.

Chemical Changes in Soil Extracts due to Liming an Acid Soil

		- Lime	+ Lime
pH		4.0	5.0
Calcium	m.e. per liter	1.0	6.0
Magnesium	m.e. per liter	1.4	0.7
Potassium	m.e. per liter	0.4	0.1
Iron	ppm	0.1	0.1
Aluminum	ppm	6.4	0.2
Manganese	ppm	16.0	7.8

U. Calif., Davis, Calif.

Parker, M. B., and Harris, M. B. SOYBEAN RESPONSE TO MOLYBDENUM AND LIME AND THE RELATIONSHIP BETWEEN YIELD AND CHEMICAL COMPOSITION. Agron. J. 54: 480-483. 1962.

Experiments were conducted during 1960 and 1961 on two moderately acid soils (Tusquitee 1 and State 1) in Northeast Georgia, to study the response of soybeans to molybdenum as affected by various rates of lime. Molybdenum treatments were applied in all combinations with various lime rates. The following conclusions were drawn:

1. Molybdenum increased soybean yields 30% in 1960 and 55% in 1961. The increase was greatest on the unlimed plots and diminished as the lime rate was increased.

2. The yield increase obtained from 0.2 pound per acre of Mo alone was equivalent to the increase obtained from 2 tons of lime.
3. Significant yield response to lime occurred only where Mo was not applied.
4. Molybdenum or lime increased leaf N, seed protein, and seed weight but decreased seed oil.
5. Significant positive correlations existed between seed yield and soil pH (where Mo was not applied), seed yield and leaf N, leaf N and seed protein, seed yield and seed protein, and seed yield and seed weight. No correlation existed between seed yield and soil pH when Mo was applied. A significant negative correlation existed between seed protein and oil.
6. No yield increase or decrease was obtained above 0.2 pound per acre of Mo. Seed treatment with Mo was superior to foliar application.

Ga. Mountain Expt. Sta., Blairsville, Ga.

Gordon, C. H., Decker, A. M., and Wiseman, H. G. SOME EFFECTS OF NITROGEN FERTILIZER, MATURITY, AND LIGHT ON THE COMPOSITION OF ORCHARDGRASS. Agron. J. 54: 376-378. 1962.

Fertilization with 400 to 1,200 pounds of ammonium nitrate produced orchardgrass forage with a markedly higher crude protein and nitrate content and a lower dry matter content as compared to control forage. These effects continued from the vegetative stage through the seed stage although they become less pronounced with advanced maturity. Lower sugar content in the fertilized forage was observed prior to flowering. Shading of fertilized areas generally increased the effects obtained from fertilization only. Since the highest level of nitrate obtained with these treatments was 2.4 percent, toxic levels of nitrate in commercially produced orchardgrass appear unlikely. No evidence was found in the literature that this level would be toxic to cattle under usual feeding conditions.

AHRD, ARS, USDA, College Park, Md.

Lehr, J. J., Wybenga, J. M., and Hoekendijk, J. A. ON THE INFLUENCE OF NITROGEN ON THE FORMATION OF CHLOROPHYLL WITH SPECIAL REGARD TO A DIFFERENCE IN EFFECT BETWEEN SODIUM NITRATE AND CALCIUM NITRATE. Plant and Soil. 17: 68-86. 1962.

The effect of nitrogen nutrition on the formation of chlorophyll was studied by means of pot experiments. Experimental crops were spinach and wheat.

On comparing the effects of sodium nitrate and calcium nitrate, it appeared that irrespective of the crop, the total quantity of chlorophyll produced per pot was nearly always greater with sodium nitrate than with calcium nitrate.

The percentage of chlorophyll in winter wheat was also higher with sodium nitrate, the differences with calcium nitrate at the vegetative stage amounting to between 6 and 29 percent.

In spinach, the chlorophyll content was lower with sodium nitrate than with calcium nitrate, owing to the much larger yield increase produced by the former.

The ratio of chlorophyll a to chlorophyll b appeared to be little dependent on the nitrate form but to vary with the nitrogen level. Especially under conditions of nitrogen deficiency, much lower ratios of a/b were found.

In young wheat leaves, a rather close relation was found between the chlorophyll content and the protein content, the ratios being 6.0:100 in the 1958 experiment and 5.7:100 in the 1959 experiment.

Plant Nutr. Res. Lab., Chilean Nitrate Agr. Serv., Wageningen, The Netherlands.

Giddens, J., Perkins, H. F., and Walker, L. C. MOVEMENT OF NUTRIENTS IN COASTAL BERMUDAGRASS. Agron. J. 54: 379-382. 1962.

Coastal bermudagrass was grown in soil and sand culture by planting in pots and allowing runners to form roots in surrounding pots. The center pots received all necessary nutrients while surrounding pots received all nutrients except N, P, K, or Ca. Plants were analyzed for these four elements. In the sand culture P-32 was applied to the center pot and counts per minute and radioautographs were made on the tissue. While some movement of the inorganic nutrients occurred there was apparently insufficient movement beyond the peg-down point to supply nutrient needs. Broadcasting fertilizer and lime should be more effective for Coastal bermudagrass than either drill or row application.

U. Ga., Col. Agr. Expt. Sta., Athens, Ga.

Walker, L. C., and Youngberg, C. T. RESPONSE OF SLASH PINE TO NITROGEN AND PHOSPHORUS FERTILIZATION. Soil Sci. Soc. Amer. Proc. 26: 399-401. 1962.

A slash pine plantation in the lower Coastal Plain of Georgia was fertilized at age 9 with 200 pounds per acre of N, 44 pounds per acre of P, and with both elements. Diameter and basal area growth response to N was obtained for each of the first 3 years following treatment, but maximum stimulation occurred the year after fertilization. Diameter growth of the largest 400 trees per acre was also significantly increased by N treatment. P supplements gave no response in the deep sandy soil. Height growth responses were not apparent.

Concentration of N in needles was increased 1 year after treatment, but by the end of the third growing season, no differences were apparent for N, P, K, and Ca content in foliage. Chemical analyses are also given for L (litter layer) and F (fermentation) layers, the latter being high in N. Neither needle lengths nor soil analyses differed between treatments after 3 years.

U. Ga., Athens, Ga.

Vicente-Chandler, J., Pearson, R. W., Abruna, F., and Silva, S. POTASSIUM FERTILIZATION OF INTENSIVELY MANAGED GRASSES UNDER HUMID TROPICAL CONDITIONS. Agron. J. 54: 450-453. 1962.

The effects of annual K applications, varying from 0 to 1,600 pounds per acre, on the yields and composition of intensively managed napier, guinea, pangola, and para grasses

and on exchangeable K content of a Fajardo c in the humid region of Puerto Rico were determined over a 3-year period.

Yields of all grasses except pangola increased sharply with K rates up to 400 pounds per acre yearly, and at a more gradual rate with higher applications. Pangola responded strongly only to the 200-pound K rate. Exchangeable K content of the soil was maintained when 800 pounds of K were applied per acre annually but was depleted at the rate of about 65 pounds per acre yearly when no K was applied.

About two-thirds of the applied K was recovered in the forage when 800 pounds or less were applied per acre yearly. At higher rates, recovery was less but exchangeable K content of the soil increased so that most of the applied K could be accounted for, relatively little being lost by leaching or fixation.

Potassium content of the forage increased sharply with rates. A K content of 1.5-2.0 percent was associated with high yields of these grasses. Protein, Ca, and P content of the forages decreased slightly and Mg content generally decreased more sharply with increasing K fertilization.

SWCRD, ARS, USDA, Rio Piedras, Puerto Rico.

Robinson, R. R., Rhykerd, C. L., and Gross, C. F. POTASSIUM UPTAKE BY ORCHARD-GRASS AS AFFECTED BY TIME, FREQUENCY, AND RATE OF POTASSIUM FERTILIZATION. *Agron. J.* 54: 351-353. 1962.

The effect of time, frequency, and rate of K fertilization on K uptake by orchardgrass on Hagerstown s₁c₁ was studied over a 6-year period. Potassium fertilization prolonged the stand of orchardgrass and increased yields of herbage. On plots receiving no K, much of the orchardgrass was replaced by volunteer Kentucky bluegrass.

These studies with grasses alone, show that time of application of K fertilizer has a marked effect on the seasonal uptake of K. The herbage from plots receiving no K fertilizer was low in percentage K but with a definite trend toward a higher K content in the spring and a lower content in the summer and fall. Single, light applications of K either in the fall or spring aggravated this trend. A single summer application largely overcame the tendency toward luxury consumption in the spring and starvation in the fall and was relatively effective in maintaining a moderate level of available K throughout the year. However, with longer growing seasons and more favorable rainfall than during the present experiment, a single application of K may well prove inadequate, particularly on soils low in K supplying power.

Results with split applications of K were disappointing probably because too much of the K (50%) was applied in the spring. Where split applications are needed, a substantial part of the total should be applied during the summer.

Calculated recovery of fertilizer K for all treatments average 99.6 percent of which 90.6 percent was recovered in the herbage and 9.0 percent was residual exchangeable K in the soil. Most of the residual K was in the 0- to 3-inch soil layer.

Jr. Author, U.S. Regional Pasture Res. Lab., SWCRD, ARS, USDA, University Park, Pa.

Wallace A., Jeffreys, R. A., and Hale, V. Q. DIFFERENTIAL ABILITY OF TWO SOYBEAN VARIETIES TO TAKE UP Fe⁵⁹ FROM SOIL ADDED TO A NUTRIENT SOLUTION. *Soil Sci.* 94: 111-114. 1962.

Hawkeye and PI 54619-5-1 soybeans were grown in solution culture to which a small quantity of calcereous soil previously labeled with Fe-59 has been added as a source of iron

and other micronutrients. The PI 54619-5-1 soybeans became chlorotic and contained a very low amount of Fe-59 in leaves. Differences in roots were less pronounced. When the two soybean varieties were grown together in the same solution, the PI 54619-5-1 inhibited Fe-59 uptake by the Hawkeye, but the Hawkeye had no influence on Fe-59 in the PI 54619-5-1.

Hawkeye and PI 54619-5-1 soybeans were also grown in soil-solution mixtures containing Fe-59 with added organic chemicals that are believed to be commonly excreted by plant roots, and in mixtures with soils of varying pH. Citrate, flavin, and glycine inhibited Fe-59 uptake with Hawkeye soybeans. With PI 54619-5-1 soybeans, the uptake was so low that the chemicals caused no further inhibition. EDDHA resulted in large increases in Fe-59 uptake in roots and tops of both varieties, but that in leaves was twice as high for the Hawkeye. Soils of high pH resulted in decreased uptake of Fe-59 for both soybean varieties, but a high pH decreased Fe-59 uptake more with the PI 54619-5-1 soybean than with Hawkeye.

U. Calif., Los Angeles, Calif.

Wilcox, G. E. POTATO NUTRITION IN SOUTHWESTERN INDIANA. Ind. Acad. Sci. Proc. 70: 243-247. 1961.

Kennebec potatoes grown on a Genessee s1 soil that contained 161 pounds exchangeable K₂O per acre did not respond to potassium fertilization in 1959. Two years of potato production decreased the level of exchangeable potassium in the soil to about 100 pounds per acre. Potatoes responded to potassium fertilization the second year when the yield was increased from 245 to 310 cwt. per acre by the application of 225 pounds K₂O. Potato chips from the zero K plots were dark brown and of inferior quality. The highest quality potatoes were produced at the higher fertilizer rates.

Nitrogen rates over the range of 32 to 164 pounds per acre did not affect either the yield or the quality of the potatoes.

The soil contained 80 pounds available P₂O₅ per acre and yield was increased from 244 cwt. per acre to 348 cwt. per acre by the addition of 192 pounds P₂O₅ per acre.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Wright, N. EFFECTS OF MANAGEMENT PRACTICES ON FORAGE YIELD AND PERCENT PROTEIN IN BLUE PANICGRASS (PANICUM ANTIDOTALE RETZ). Agron. J. 54: 413-416. 1962.

Three experiments were conducted to study the effects of management practices on forage yield and percent protein in blue panicgrass. Experiments were: (1) N, P, and K fertilizers; (2) 4 clipping heights; and 3 stages of maturity at harvesting; and (3) 4 soil-moisture stress depths. Nitrogen increased forage yield at the 1 percent level of significance through 525 pounds per acre the first year and through 700 pounds per acre the second year. Percent protein was significantly increased (1 percent level) by N application. The highest protein values were 875 pounds of N per acre. Highly significant correlation coefficients were found between yield and percent protein. Forage yield and protein percent were not increased by any of the fertilizer interactions. Dry-matter percent decreased as N levels increased.

Significant differences in forage yield were found between stages of maturity. Considering maturity stages the results indicated that highest yield was attained when the forage was harvested when the majority of the seed heads had emerged from the boot (early stage) at harvesting. A highly significant yield response to higher clipping heights was found for both years. The 12-inch clipping height resulted in the highest yield for both years, but was not significantly different (1 percent level) from the 9-inch height the first year. A highly significant interaction (maturity X clipping height) showed that the influence of clipping height should be considered at a given maturity stage for each year. Highest yield (1 percent level) for both years was the early-maturity stage clipped at 12 inches. Percent protein was significantly (1 percent level) influenced by maturity stage. The results showed that protein decreased as blue panicgrass matured. Clipping height and the interaction (maturity X clipping height) did not affect protein percent.

Soil-moisture-stress treatments did not decrease yield when the data were combined for years. Yield was significantly reduced the second year and the year X stress interaction was significant. The percent protein was not affected by soil-moisture stress. The data (2 years) showed that blue panicgrass has a relatively broad tolerance to soil moisture levels.

Results suggest the desirability of combining treatments for highest forage yield. Management would then include harvesting at the early stage of maturity (majority of seed heads emerged from boot), leaving a minimum stubble height of 12 inches, and applying 500 to 700 pounds of N per acre. Forage yield was surprisingly high under the conditions of limited soil moisture; however, forage yield was reduced below the level expected with favorable irrigation practices for all four soil-moisture stress treatments. Constant biweekly irrigations were applied to the fertilizer and maturity stage--clipping height experiments for optimum forage production. However, the results showed that an irrigation treatment for optimum forage production was not included in the moisture-stress study.

CRD, ARS, USDA, Tucson, Ariz.

Soil Classification

Johnson, W. M., Cady, J. G., and James, M. S. CHARACTERISTICS OF SOME BROWN GRUMUSOLS OF ARIZONA. Soil Sci. Soc. Amer. Proc. 26: 389-393. 1962.

Extensive areas of well-drained brown Grumusols developed from weathered ultrabasic volcanic rocks exist in north-central and eastern Arizona. They are on nearly level to rolling topography under grass; precipitation ranges from <10 to > 20 inches annually. They have clay profiles of nearly uniform brown color; moderately low organic matter content; very high base status; dominance of montmorillonite in the clay fractions; and evidence of much internal soil movement--slickensides, very gradual decrease of organic matter with depth, and diffuse or gradual and wavy horizon boundaries. Mineralogical studies indicate that in these soils the course of weathering of the rock and the nature of the weathering products are determined early and remain constant; montmorillonite is the dominant clay mineral in all horizons including the weathered material adjacent to the fresh rock. Comparisons are given with associated dark gray, poorly drained Grumusols and with dark brown soils having textural B horizons that formed under timber-grass vegetation.

The profiles are uniform over a wide range of climate except for the tendency for clay content to increase with average annual precipitation. The presence of large amounts of

basalt-derived minerals in the sand and silt and absence of evidence of unconformity between the basalt and the soil or within the soil indicate that the basalt is the parent material and that the nonbasalt minerals in the sand and silt do not indicate a significant external source of material.

The high content of weatherable minerals, such as augite and olivine, in the sand and silt throughout all the profiles and the fact that the composition of transitional weathered material close to the bedrock is essentially the same as that of the soil indicates that most of the clay forms as the rock breaks up and little weathering is going on in the solum.

In all of the locations, evidence for churning is present by the lack of textural differentiation, the slickenside-faced "lentic" structure, the presence of abundant stones and lime concretions on the surface, with few in the profile, and the homogeneous mineralogy of all this indicate movement, heaving, and turning over of the soil material. That the churning action extends to the surface of the rock is indicated by the absence in most of the localities of any transitional weathering products; as soon as the rock disintegrates and clay is formed the loosened material is swept up into the soil.

Most of the world's Grumusols have been described as dark, dull-colored clay soils. Little attention has been given to the better drained clay soils. These Arizona soils have all the important characteristics of Grumusols such as: (1) Montmorillonite clay; (2) high base saturation with Ca and Mg; (3) high shrinkage ratio, cracks, and slickensides; (4) moist and dry seasons; (5) lack of textural horizons; (6) presence of free calcium carbonate; and (7) evidence of churning.

These soils, therefore, can be classified as a well-drained, well-aerated species of Grumusol.

SCS, USDA, Washington, D.C., 20250.

McCracken, R. J., Shanks, R. E., and Clebsch, E. E. C. SOIL MORPHOLOGY AND GENESIS AT HIGHER ELEVATIONS OF THE GREAT SMOKY MOUNTAINS. Soil Sci. Soc. Amer. Proc. 26: 384-388. 1962.

Properties of soils representative of the elevation from 4,500 to 6,600 feet in the Smokies along the North Carolina-Tennessee border are given.

Mean annual rainfall exceeds 80 inches. Mean air temperatures are: Annual 45° to 49° F.; January, 31° to 35° F.; and July, 59° to 63° F. Parent rock is feldspathic sandstone and conglomerate. These soils can be placed in the following two groups: (1) Lacking A₂ horizons with this A₁ and "color B" horizons; and (2) with A₂ horizons, B_{1r} horizons, and relatively thick mor layers. Soils of the first group ordinarily occupy well-drained sites under spruce-fir forest. Those of the second group occupy less well-drained sites under heath bald or rhododendron understory of spruce-fir, with some indication that they tend to form from more quartzose conglomeratic rock.

Soils of the first group are ascribed to the Sol Brun Acide great soil group on the basis of very low base status and high exchangeable Al, C/N levels, lack of relative accumulation of free iron and of layer silicates, and lack of A₂ horizons. Second group soils are excluded from the Sol Brun Acide group, due to the presence of A₂ horizons, differential iron accumulation, and C/N levels and are interpreted as Podzols.

Possible mechanism are proposed to account for contrasting properties of the Sol Brun Acide and Podzol soils described, and the anomalous absence of A₂ in the Sol Brun Acide of

the Smokies. Extreme acid hydrolysis, producing intergradational three-layer silicates plus kaolinite and gibbsite weathering end products, was postulated for these soils.

N. C. Agr. Expt. Sta., Raleigh, N. C.

Faul, H., Stern, T. W., Thomas, H. H., and Elmore, P.L.D. AGES OF INTRUSION AND METAMORPHISM IN THE NORTHERN APPALACHIANS. Amer. J. Sci. 261: 1-19. 1962.

A series of K-Ar, Rb-Sr, and Pb/alpha age measurements in Maine, New Hampshire, and Vermont indicates a complex history of intrusion and metamorphism. Evidence of Grenville age (about 1,000 million years ago) is preserved in southwestern Vermont, and subsequent major events in Devonian (400 to 350 million years ago), Permian (270 to 230 million years ago), and Jurassic time (1800 to 130? million years ago) are observed. The appalachian age pattern is similar to that reported from the Ural Mountains and may indicate a tectonic time relationship between the Appalachians and the Urals.

U.S. Geol. Survey., U.S. Dept. Int., Washington, D.C., 20240.

Gorbunov, N. I. MOVEMENT OF COLLOIDAL AND CLAY PARTICLES IN SOILS. (PROBLEM OF LEACHING AND PODZOLIZATION). Soviet Soil Sci. 7: 712-724. July 1961.

Colloids and clay move in the soil in the form of mineral, organo-mineral, and organic compounds. The sources for the formation of colloids and clay are primary and secondary minerals as well as the decomposition products of plant and other residues of a biological origin.

As clay and colloidal fractions move, secondary (highly dispersed) and primary (slightly dispersed) minerals are being decomposed. Decomposition takes place in several stages, starting with dissolution--the replacement of the ions of the crystal lattice with the ions of the solution--and ending in the formation of amorphous and crystalline oxides.

The movement of colloids and clay is determined by the presence in the horizons, on homogeneous parent material, of concretions, ortstein, ortsand, silica powdering, and other new formations. In certain cases the soil is being enriched with clay and colloids as a result of their formation in situ.

The rate of decomposition and transformation of minerals depend on their crystallo-chemical nature, dispersion, and climatic and biochemical conditions under which weathering and soil formation take place. The opinion that primary minerals are less stable than secondary minerals is erroneous.

The signs used to determine the movement of colloids and clay with and without their decomposition, such as the presence or absence of polarizing clay, and the homogeneity or heterogeneity of the mineralogical and chemical composition, are not always reliable.

Scripta Technica Inc., Washington, D.C., 20005.

Yefimov, V. N. FORMS OF ACCUMULATION AND MIGRATION OF SUBSTANCES IN BOG SOILS. Soviet Soil Sci. 6: 643-650. June 1961.

During the transformation of peat-producing plants into peat considerable changes occur in ash content and composition.

In upland peat soils, where peat-producers and the peat itself are fed only by atmospheric waters, the humification and mineralization of the organic mass are very slow, and there is no enrichment of the peat with ash elements. When the peat and the soil waters are acid, the ash elements become mobile, are partially absorbed by plants, and are thus removed from the profile of the peat soil. There is an impoverishment of the peat in all the ash substances except Fe and Al which accumulate relatively in the form of complicated organo-mineral compounds.

There is a certain periodism in the nourishment of peat-producers by atmospheric and soft soil waters in transitional peat soils. Ash substances are also removed from the profile here under acid conditions. There is no absolute impoverishment of peat because of the considerable accumulation of Fe and Al in the form of organo-mineral compounds.

The peat-producers in the transitional maritime soil are fed by waters rich in mineral substances. The increase in the ash content of peat in the profile of these peatbeds results from the accumulation of Fe and Al in the form of organo-mineral compounds and sulfur. A considerable part of these substances is brought into the already formed peat from the outside by ground waters.

There is a considerable removal of organic substances from acid, upland, and transitional peat soils, which amounts to 100-120 mg. C per liter in bog waters. The migration of calcium and sulfur apparently occurs in the ionic form (Ca^{++} and SO_4^{--}). The migration of iron occurs both in the ionic (Fe^{++} and Fe^{+++}) form and in the form of complex organo-mineral compounds, iron sulfates, and ferrous sulfide (the last two forms are characteristic for the peat soils of maritime regions).

Continental and maritime lowland peat soils are fed by neutral waters rich in calcium. As a result of the intense humification and mineralization of peat-producers and because of the introduction of a number of elements by hard waters, the peatbed is enriched with all the mineral substances. The accumulation of iron is especially great in peat soils, and of sulfur in the maritime soils. There is no removal of organic matter in these peatbeds, because of the high Ca content in the water.

Scripta Technica Inc., Washington, D.C., 20005.

Nikonov, M. N., and Minkina, T. I. NATURE OF THE CHANGE IN PEAT UNDER THE INFLUENCE OF AERATION, Soviet Soil Sci. 1: 63-67. Jan. 1961.

Rapid changes occur in peat layers under the influence of aeration, which are reflected both in the morphology and composition of the peat.

The plant fiber becomes decomposed and the peat becomes enriched in biochemically stable elements.

Parallel with the increase in the degree of decomposition of peat, its ash content increases because of the mineralization of its organic substances. These processes are more intense in peats, which initially have a low degree of decomposition, and are slower in well-decomposed peats.

The peats become enriched in bitumens and humic acids. The content of all other fractions of the organic substances of peats (substances extractable with alcohol, fulvic acids, easily hydrolyzed substances, cellulose, and non-hydrolyzable residue) decreases similarly, primarily because of mineralization.

The intense mineralization of organic substances is not accompanied by any substantial losses of nitrogen, so that peat becomes enriched with it under the influence of aeration.

Processes taking place in aerated peat layers are morphologically similar in many respects to processes of peat formation, but differ greatly from them by the nature of the changes in the chemical composition of organic substances. If in the first case the decomposition of plant fiber is accompanied by the intense mineralization of organic substances and

by only a slight accumulation of humic acids, then during peat formation humification proceeds without significant losses of organic matter.

Scripta Technica Inc., Washington, D.C., 20005.

Papadakis, J. SOME CONSIDERATIONS ON SOIL CLASSIFICATION: THE 7th APPROXIMATION. *Soil Sci.* 94: 115-119. 1962.

Although there are great differences in the various systems of soil classification, all these systems recognize the same major groupings. The differences concern the limits or definition of the individual groupings and the positions of these groupings in the classification system. The 7th approximation precisely defines all groups, major and minor, and thus offers a concrete basis which serves as a starting point for further possible improvements, and finally the achievement of a generally accepted system. Points of the 7th approximation on which there may be disagreement are reviewed and tentative amendments that might eliminate them are proposed. The more important amendments aim to: (1) Maintain the unity of "sols bruns"; (2) extend the limits of dry, forest soils ("rouges mediterraneens," "Korichnevie," etc.); and (3) fix stricter limits for grassland and desert soils. The use of indirect methods that take clay mineralogy and organic matter composition into account (for example, sedimentation volume and 1-g. ball resistance) was proposed.

Instituto de Suelos y Agrotecnia, Buenos Aires, Argentina.

Frye, J. C., Glass, H. D., and William, H. B. STRATIGRAPHY AND MINERALOGY OF THE WISCONSINAN LOESSES OF ILLINOIS. *Ill. State Geol. Survey C.* 334, 55 pp. 1962.

Loess deposits of Wisconsinan age cover more than three-fourths of Illinois and are important as ceramic raw materials, as parent materials of soil, in construction, and in the study of ground-water geology. This report contains the results of analyses by X-ray diffraction, petrographic microscopy, or wet chemistry of 583 samples of loess and related materials. The clay mineral and heavy mineral assemblages of the several stratigraphic units are significantly different and are characteristic of the units. The differences in mineral content also indicate from which major outwash-carrying valleys the several loesses originated and relate the loesses to the up-valley glaciers that provided the outwash. The striking decrease from west to east (Mississippi-Illinois Valley to Ohio-Wabash Valley) in the relative abundance of montmorillonite is consistent with the changes in the mineralogy of the tills.

Tables, Maps, and graphs.

Ill. State Geological Survey, Urbana, Illinois.

Perkins, H. F., England, C. B., and Gibbs, J. A. SOME MORPHOLOGICAL, PHYSICAL, CHEMICAL AND CLAY MINERAL CHARACTERISTICS OF SEVERAL AGRICULTURALLY IMPORTANT GEORGIA SOILS. *Ga. Agr. Expt. Sta. Tech. B. N. S.* 26, 37 pp. 1962.

Soil samples were collected from three major horizons from a total of 46 locations representing 14 agriculturally important soil series in Georgia. Morphological features, mechanical analysis values, and important chemical properties were determined.

Residuum from which the parent materials were derived ranges from consolidated crystalline rock to unconsolidated marine sediments. Except where erosion has removed much of the surface, a vast majority of the soils have loamy sand, sandy loam, or loam

surface textures regardless of the parent material residuum. Surface soils are predominantly very friable to friable and have granular structure. Subsoils or B horizons are generally friable or firm loams, or clays having block-like structure.

Chemically, most soils are moderately to strongly acid, have relatively low cation exchange capacity values, and are generally low in plant nutrient elements. The one notable exception is the B₂ horizon of the Iredell series, which has cation exchange capacity values in excess of 20 m.e./100 gm. Base saturation and organic matter values are apparently influenced by previous soil treatments, particularly in the surface horizons where data varied widely within and between series.

Kaolinite is the dominant clay mineral in most of the soils investigated. Vermiculite is present in significant quantities but usually occurs to a lesser extent than kaolinite. Small amounts of illite, gibbsite, goethite, quartz, amorphous material, and interstratified minerals were detected in some profiles.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Athens, Ga.

Nelson, L. A., and McCracken, R. J. PROPERTIES OF NORFOLK AND PORTSMOUTH SOILS: STATISTICAL SUMMARIZATION AND INFLUENCE ON CORN YIELDS. Soil Sci. Soc. Amer. Proc. 26: 497-502. 1962.

Results of chemical, mineralogical, and physical characterizations of 15 profiles each of Norfolk and Portsmouth soils of the North Carolina Coastal Plain are reported. Purposes of the study were to: (1) Determine central tendencies, ranges, and standard deviations of properties; and (2) weight those properties most promising as differentiating criteria for soil classification and characterization. Multiple linear regression techniques were used for this selection and weighting.

The conclusions were: (1) A wide range in properties exists within each of these soil series. (2) Multiple regression techniques may be used to evaluate soil properties as criteria of soil classification and characterization but certain problems are involved. These include the dependence of variables, and the occurrence of irrational signs. (3) The factors most promising as differentiating criteria for these soil series are the mineral index ($14\text{ \AA}/7\text{ \AA}$ ratio for the $< 2\text{ }\mu$ fraction of the surface horizon) and nitrate production. Importance of the mineral index depends to an unknown degree upon its correlation with other soil properties with which it is associated. A number of other factors occurring in the multiple regression models were selected as potential differentiating criteria. Among these are such field-determinable characteristics as depth of A horizon and clay content of the B₂ horizon and such fertility factors as acid-extractable P and K and exchangeable A1. And (4) the number of profile samples ordinarily used in soil characterization studies is inadequate for estimating the mean within 25% for most properties important in relation to crop yield (corn yield in this case). Fifteen profile samples per series were inadequate for some properties. The properties to receive emphasis should determine the number of profile samples required.

Jr. Author, N.C. State Col., Raleigh, N.C.

EROSION CONTROL

Wind and Water Erosion

Hockensmith, R. D., and Steele, J. G. SOIL EROSION--THE WORK OF UNCONTROLLED WATER. U.S. Dept. Agr., Soil Conserv. Serv. Agr. Inform. B. 260, 16 pp. 1962.

Many effects of soil erosion due to uncontrolled water are illustrated by photographs and are described in the narrative report.

SCS, USDA, Inform. Div., Washington, D.C., 20250.

Anderson, H. W. CURRENT RESEARCH ON SEDIMENTATION AND EROSION IN CALIFORNIA WILDLANDS. International Assoc. Sci. Hydrol. Comn. Land Erosion 59: 173-182. 1962.

Sediment sources in California Wildlands are being evaluated by relating measured suspended sediment and reservoir deposition to meteorological, topographic, vegetation, land use, and surface soil erodibility variables. Erodibility--as indexed by the surface-aggregation ratio and the dispersion ratio of the soil--is predictable from rock type, vegetation type, and land elevation. Brush soils have 30 percent higher erodibility than grass soils. Soils at low elevations are 40 percent more erodible than those found above 1,500-foot elevation.

Sediment production after logging was found to increase eight-fold the first year after tree harvest and to diminish rapidly in succeeding years. Erosion of logging roads, skid trails, and landings across minor drainage channels was the chief source of sediment.

The effects of forest fires and post-fire treatments on sedimentation are being evaluated in two groups of experimental watersheds. Post-fire treatments include salvage logging, contour terrace piling of small trees and brush, seeding to grass, contour planting of cereal barley, and channel check dams. Increase in sedimentation has occurred chiefly during high-intensity precipitation.

Pacific Southwest Forest & Range Expt. Sta., Forest Serv., U.S. Dept. Agr., Berkeley, Calif.

Soil and Water Conservation Research Division. SOIL AND WATER CONSERVATION RESEARCH IN THE PACIFIC COAST REGION. U.S. Dept. Agr., Agr. Res. Serv. Misc. P. 900, 26 pp. 1962.

Soil and water research in the Pacific coast area is especially concerned with soil moisture and water entry in soils. Much of the rainfall and the water applied for irrigation evaporates from the soils. In places, water moves upward from ground water tables and evaporates at the soil surface; soils then become salinized. In other places sodic soils need to be reclaimed by leaching with high-salt water.

Existing irrigation and drainage systems need to be redesigned or operated more efficiently. Ground water studies are essential: To understand the processes of recharging reservoirs and wells; to facilitate recharging in order to have sufficient water during dry periods; and to locate areas for recharging when there is excess water.

Fertilizer studies are continuing in order that a proper balance is obtained between plant food and water use.

A few examples of recent soil and water conservation research in the Pacific Coast Region are described and illustrated.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Soil and Water Conservation Research Division. SOIL AND WATER CONSERVATION RESEARCH IN THE GREAT PLAINS STATES. U.S. Dept. Agr., Agr. Res. Serv. Misc. P. 902, 28 pp. 1962.

Conservation, efficient use, and management of available moisture supplies for plant growth on cropland and grassland are major problems in the Great Plains. In much of the southern Plains, moisture conservation and soil blowing as a result of limited rainfall are closely related. In the eastern half of the Great Plains, water erosion continues to be one of the very difficult conservation problems.

Irrigation has increased rapidly in the Plains since 1940. Irrigation water management practices have a major effect on water erosion; in a poorly designed irrigation system, the water application can cause serious erosion to fields.

The solution of soil and water conservation problems requires an intensive field experimental and investigational program supported by adequate laboratory and greenhouse research. From this research, practices are developed that can be applied to the land to conserve our resources.

A few examples of recent soil and water conservation research in the Great Plains area are described and illustrated.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Terracing

McCool, D. K., Beasley, R. P., and Berry, I. L. TERRACE CHANNEL DESIGN USING SPATIALLY VARIED FLOW AND TRACTIVE FORCE THEORIES. Trans. ASAE 5: 190-196. 1962.

Two hypothetical terrace channels were chosen for design by the theoretical method. A channel with six-foot bottom and eight-to-one side slopes was chosen for land of 6 percent or less slope. A channel with four-foot bottom and six-to-one side slopes was chosen for land of greater than 6 percent slope. A range of inflow of 0.5 to 1.5 c.f.s. per 100 ft. was used in the design of the channel for land of less than 6 percent slope. A range of inflow of 0.5 to 1.0 c.f.s. per 100 ft. was used in the design of the channel for land of greater than 6 percent slope. These ranges were divided into 0.25 c.f.s. intervals. Design tractive force values of 0.100 to 0.200 p.s.f. were chosen. This range was divided into 0.025 p.s.f. intervals.

The grade, depth, and velocity data for a design tractive force of 0.200 p.s.f. and an inflow of 1.5 c.f.s. per 100 ft. into the channel with six-foot bottom and eight-to-one side slopes are presented in Table 1. The Froude number was less than unity for each 100-ft. length of this channel, indicating the flow to be at mild grade. Any grade less than that indicated in Table 1 would result in a tractive or shearing force less than the design tractive force, if inflow and roughness were the same. Table 1 shows that design for a permissible tractive force allows the use of higher grades toward the upper end of a terrace than the lower end. Table 1 also shows that the velocity obtained by designing for permissible tractive force is not constant but decreases toward the upper end of the channel, indicating that design based on the limiting velocity criteria would result in increasing tractive force toward the upper end of the channel.

TABLE 1. Design Data for a Trapezoidal Channel with Six-foot Bottom Width and 8:1 Side Slopes

($T = 0.2$ psf; $q = 1.5$ cfs/100 ft.; $n = 0.03$)

Distance from upper end of channel	Channel gradient	Depth of flow	Velocity
X (100 ft.)	S_o (percent)	y (ft.)	V (fps)
1	2.89	0.12	1.80
2	1.69	.21	1.89
3	1.25	.28	1.93
4	1.01	.35	1.95
5	.89	.41	1.97
6	.76	.47	1.98
7	.69	.52	1.99
8	.63	.57	2.00
9	.58	.61	2.01
10	.54	.66	2.02
11	.51	.70	2.03
12	.48	.74	2.03
13	.46	.78	2.04
14	.44	.82	2.04
15	.42	.86	2.05
16	.40	.89	2.05
17	.39	.93	2.06
18	.38	.96	2.06
19	.36	.99	2.07
20	.35	1.02	2.07

Data for all the possible combinations of inflow and tractive force for the two channels are presented in Missouri Agricultural Experiment Station research bulletin No. 778.

SWCRD, ARS, USDA, Stillwater, Okla.

Critical Areas

Diseker, E. G., and Richardson, E. C. EROSION RATES AND CONTROL METHODS ON HIGHWAY CUTS. Trans. ASAE 5: 153-155. 1962.

Because of the vast expanse of the primary and secondary road system and its potential as a source of damaging sediment and flood runoff, research studies of roadside erosion processes and stabilization techniques were initiated by the Soil and Water Conservation Research Division, ARS, USDA, near Cartersville, Ga., in the fall of 1956.

The effect of bank slope on erosion has not been completely consistent although for the 3 years of record the flatter slopes had substantially less erosion than any of the other plots. The average annual erosion for these two plots was 86 tons per acre. For the steep-slope plots the average annual erosion was 153 tons per acre, but for the medium-slope plots it was 205 tons per acre. The low 3-year average of erosion on the steep banks is due largely to the facts that: (1) Rainfall was 5.18 inches greater on the medium than on the steep banks; (2) soil was firm on the steep banks for 1 year after they were sloped thus lessening the infiltration; and (3) almost no frost action occurred on the steep banks in 1958. For the year 1960, the results appear to be more in line with what might be expected, the flat slope plots having an average of 100, the medium slope plots 139, and the steep slope plots 195 tons of erosion per acre. The annual soil losses from the six plots have ranged from 41 to 359 tons per acre annually.

The vegetation studies have shown that mulching is necessary to anchor seed and fertilizer on bank slopes of 2:1 or steeper under Piedmont conditions. The mulch provides protection against frost action, raindrop impact, and erosion until the vegetation has had opportunity to become well established. Wheat straw, pine straw, and sawdust were the most effective mulches used to aid in the establishment of a crownvetch cover.

For the cool season grasses fescue, orchard grass and smooth brome grass appeared, in the order named, to be the most promising for providing an effective cover. Abruzzi rye provided a cover quickly, developed an effective mulch grown-in-place, and was an excellent nurse crop for slowly developing crownvetch.

Crownvetch was the most promising perennial legume for roadbank vegetation in the project area. An excellent cover resulted when lespedeza sericea developed full stands, but it was not adaptable to wet areas, and stands were weakened when mowed in late summer.

Satisfactory cover was obtained with common Bermuda and lovegrass, especially in areas exposed to sufficient sunlight. Wilmington and Pensacola bahias were successful and apparently better adapted to difficult sites than Bermuda.

The vine-type plants most adaptable to rough, steep areas were honeysuckle and kudzu. English ivy was hard to establish and grew very slowly. Although Vinca minor survived better and grew faster than ivy, both were injured by sunscald and were killed on Southern exposures.

Many of the grass sods could not survive the competition of adjacent timber areas, but broomsedge, honeysuckle, kudzu, and sericea developed in these areas even when partially shaded.

Certain areas were fertilized, or mulched and fertilized, without seeding in order to develop native species. Some excellent results were obtained where broomsedge and other native plants were present.

SWCRD, ARS, USDA, Cartersville, Ga.

Soil Conservation 28(3): 51-71. 1962.

The October issue of "Soil Conservation" is devoted to articles on roadside improvement. The following list presents the author, title, and address of author for each article:

1. Walker, R. T. FEDERAL AND STATE ROAD AGENCIES BATTLE EROSION. U.S. Bur. Public Roads, Washington, D.C., 20250.
2. Bennett, J. S. SCHOOL CONSERVATION PROJECT HEALS--BEAUTIFIES FREE-WAY EYESORE. SCS, USDA, Warren, Ohio.
3. Roth, B. A. VIPS FOR ROADSIDE IMPROVEMENT. SCS, USDA, Upper Darby, Pa.
4. Graetz, K. E., and Jent, C. H. ROADBANK REVOLUTION. SCS, USDA, Raleigh, N.C.

5. Smith, W. L. BASAL PLANT DENSITY GUIDE TO PROTECTING HIGHWAYS-- OTHER SLOPES. SCS, USDA, Denton, Tex.
6. Williams, D. A. CONSERVATION FOR BETTER ROADS MOVES AHEAD. SCS, USDA, Washington, D.C. 20250.
7. Griffin, R. K. ROADSIDE EROSION CONTROL AT AIR FORCE ACADEMY. SCS, USDA, Colorado Springs, Colo.
8. Thornton, R. B., and Williams, C. L. BETTER PLANTS FOR RAW BANKS. SCS, USDA, Beltsville, Md.
9. Tegner, R. F. PESKY WEEDS LICKED AS ROADSIDE PROBLEM. SCS, USDA, Berkeley, Calif.
10. Caryl, N. R. WEST VIRGINIA ROAD COMMISSION SETS PATTERN. SCS, USDA, Romney, W. Va.
11. Richardson, E. C., and Diseker, E. G. FERTILIZED NATIVE PLANTS PROMISE QUICK AND CHEAP ROADBANK PROTECTION. SWCRD, ARS, USDA, Cartersville, Ga.
12. Fox, L. MARYLAND HIGHWAY CONSERVATION PROVIDES RECREATION. SCS, USDA, Upper Darby, Pa.
13. Davis, R. M. COUNTY BUILDS ROAD TO SERVE WATERSHED PROJECT. SCS, USDA, Emporia, Kans.

Brown, R. L. STABILIZING SAND DUNES ON THE PACIFIC COAST WITH WOODY PLANTS. U.S. Dept. Agr., Soil Conserv. Serv. Misc. P. 892, 18 pp. 1962.

Establishing and maintaining permanent vegetation has proved to be the most effective and efficient means of stabilizing coastal sand dunes. The dune areas on the Pacific coast of North America are the result of accelerated erosion caused primarily by the destruction of a cover of native vegetation. In some areas the climax cover was herbaceous, in others it was woody, and in still others it was a combination of herbaceous and woody plants. The choice of plants for the reconstruction of a permanent cover depends on the inherent limitations of the site and the intended land use for the area.

SCS, USDA, Inform. Div., Washington, D.C. 20250.

SOIL MANAGEMENT

Cropping Practices

Shaw, W. C., Shepherd, D. R., Robinson, E. L., and Sand, P. F. ADVANCES IN WITCH-WEED CONTROL. Weeds. 10: 182-192. 1962.

Witchweed (Striga asiatica), a parasitic chlorophyll-bearing plant (Scrophuladiaceae) that attacks corn, sorghum, sugarcane, and more than 60 other important crop plants and weeds belonging to the grass family, was found in North Carolina and South Carolina in 1956. It presents a potential hazard to the production of grain crops with an annual value of more than 5 billion dollars in the United States. Continued extensive surveys indicate that witchweed is now present in 20 counties in North Carolina and 10 in South Carolina on a total of 9,566 farms containing 210,671 acres. Federal interstate and state intrastate quarantines were established to reduce its spread. Witchweed produces up to 500,000 microscopic

longlived seeds per plant. These do not usually germinate until stimulated by a chemical stimulant secreted by the roots of certain plants. A stimulant has been isolated from corn but its exact chemical structure has not been determined. More than 300 chemicals have been evaluated in the laboratory in attempts to find a synthetic stimulant. Of these, 18 stimulated witchweed seed germination in the laboratory but they have not been evaluated for their effectiveness in controlling witchweed under field conditions. After 4 years of catch or trap crops, excellent control of witchweed has been obtained and highly profitable crops of corn have been produced on heavily infested land. Corn grown continuously with witchweed seed production prevented by 2,4-D has resulted in excellent witchweed control and high corn yields. Corn grown continuously receiving 2,3,6-trichlorophenylacetic acid (fenac) as a pre-planting soil-incorporated treatment and 2,4-D as a post-emergence spray as needed have proved effective full-season control of witchweed. Tobacco and certain other crops cannot be grown in rotation with corn for a period of 2 years after this treatment because of fenac residues in the soil.

CRD, ARS, USDA, Beltsville, Md. 20705.

Crop Residue Management

Parker, D. T., and Larson, W. E. CROP RESIDUE PLACEMENT IN SOIL AND ITS EFFECT UPON GROWTH OF CORN. *Agron. J.* 54: 263-267. 1962.

A mulch of crop residue as compared to a like amount of residue plowed into the soil significantly retarded plant growth. This retardation occurred independently of N fertility, soil moisture, and soil compaction. Interactions between residue placement and the other variables was sometimes observed.

SWCRD, ARS, USDA, Ames, Iowa 50010.

Guenzi, W. D., and McCalla, T. M. INHIBITION OF GERMINATION AND SEEDLING DEVELOPMENT BY CROP RESIDUES. *Soil Sci. Soc. Amer. Proc.* 26: 456-458. 1962.

Wheat and oat straw, soybean and sweetclover hay, corn and sorghum stalks, bromegrass, and sweetclover stems were extracted with hot and cold water, using 1 part of residue to 15 parts of water. One-half of the water extract of each residue was autoclaved for 1 hour at 20 pounds' steam pressure. In addition, wheat straw was extracted with ethanol and the extract was separated into strong and weak acids, neutral, basic, and water-soluble compounds. The ethanol-soluble compounds were tested for their effect on wheat, whereas the hot and cold water extracts of residues were tested for their effect on germination and growth of wheat, sorghum, and corn seeds.

All the residues contained water-soluble substances that inhibited the germination and growth of sorghum, corn, and wheat. The cold water extracted more toxic materials than did the hot water. Autoclaving increased the toxic effect of the water extract of residues on root growth. The toxic effect on germination and shoot growth was decreased for most residues by autoclaving of aqueous extract. Ethanol-soluble substances of wheat straw inhibited in germination and growth of wheat seeds. The ethanol extract of wheat straw, separated into strong acid, water-soluble, neutral, weak acid, and basic compounds, showed decreasing toxicity in the order listed.

SWCRD, ARS, USDA, Lincoln, Nebr.

McCalla, T. M., Army, T. J., and Wiese, A. F. COMPARISON OF THE EFFECTS OF CHEMICAL AND SWEEP TILLAGE METHODS OF SUMMER FALLOW ON SOME PROPERTIES OF PULLMAN SILTY CLAY LOAM. Agron. J. 54: 404-407. 1962.

On Pullman silt. at Bushland, Tex., two methods of stubble mulch summer fallow, chemical and sweep tillage, were tested for their effects on the physical, chemical, and biological properties of the soil. In addition, the effects of herbicides on nitrification rates and oxygen uptake of soil were determined.

In the field study, percent soil aggregation as determined by wet sieve method, organic matter, pH, fungi, and total counts of bacteria and actinomycetes were not influenced by the use of dalapon, 2,4-D, or amitrole during the fallow period. Nematodes were reduced by the use of these chemicals. Dry soil aggregation was increased slightly by sweep tillage but only for a short period immediately following cultivation. Nitrate content was reduced with chemical weed control during fallow. The use of herbicides during the fallow period might aggravate nitrogen deficiencies often found where stubble-mulch tillage has been used.

In laboratory studies where soil moisture was maintained at a high level and amitrole, 2,4-D, dalapon, and PBA were applied at rates normally used in the field, nitrification initially tended to be retarded but subsequently was not affected or increased. Addition of excessively high rates of herbicides to the soil resulted in stimulated nitrification with amitrole and 2,4-D, and retardation with PBA and dalapon. After a few days of incubation, oxygen uptake by the microorganisms in the Pullman soil was retarded slightly by excessively high additions of PBA and 2,4-D.

SWCRD, ARS, USDA, Lincoln, Nebr.

Horning, T. R. STUBBLE MULCHING IN THE NORTHWEST. U.S. Dept. Agr., Agr. Res. Serv. Agr. Inform. B. 253, 28 pp. 1962.

The essentials for successful stubble-mulch farming in a wheat-fallow system, based on results of experiments and observations over the past 10 years, are:

1. A straw spreader on the combine promotes uniform straw distribution, which greatly facilitates mulch tillage and seeding in mulches, especially when straw yields are high.
2. Pretillage mulching (stubble reduction) is usually necessary if straw is not uniformly distributed, or if yields are 4,000 pounds or more per acre. Stubble busters, skew treaders, or spike-toothed harrows are used for this operation.
3. Mulching can be performed in the fall after harvest, or in the spring before or after initial tillage. Fall work is recommended only to distribute the workload, to avoid difficulties in a wet spring, or to assure a satisfactory job when stubble and soil are dry.
4. Initial tillage normally should be done in the spring after weed and volunteer grain growth has begun and the immediate surface soil has dried out. Stubble cultivators, subsurface sweeps, or one-way disks are the most satisfactory implements. Moldboard plows should not be used unless modified by replacing the moldboard with a narrow metal plate. Disk plows equipped with large, widespread disks can be used in stony ground, or in excessively heavy stubble if properly operated to avoid burying too much of the residue. Depth of operation should not exceed 4 to 6 inches.
5. The initial tillage operation can be performed in the fall following harvest. Fall tillage is recommended only where soil freezing is common, or where a severe weed or volunteer-grain problem exists.

6. Essential features for the successful operation of tillage equipment are adequate vertical and horizontal clearance to avoid clogging, and a shallow and uniform depth of operation.
7. A follow up tillage, as soon as possible after initial spring tillage, is needed to complete the weed kill, to pack the soil, or both. The skew treader, rod weeder, or stubble cultivator are recommended, depending on the amount of residue, climatic conditions, and growth of weeds and volunteer grain.
8. Summer weeding operations can be accomplished with the rod weeder, stubble cultivator, or medium-width sweeps (24 to 30 inches wide). Tillage should be performed only often enough to control weeds, and should not exceed 3 to 4 inches in depth. If residues after initial tillage are less than 3,000 pounds per acre, care should be taken during subsequent tillages to leave as much residue on or near the soil surface as possible.
9. Every tillage operation should fulfill a specific need. Any tillage in excess of this need not only costs extra money, but reduces protective residues, and adversely affects soil condition.
10. Drilling is best accomplished with deep- or semi-deep furrow drills with wide row spacing (8 to 14 inches). Closed packer wheels cause less disturbance of residue and soil between rows than open wheels. Seed must be placed in firm moist soil, and uniformly covered and packed.

With an effective program of stubble mulching, sustained high yields can be obtained, and soil losses by wind and water erosion can be materially reduced.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Tillage

Van Doren, D. M., Jr., and Ryder, G. J. FACTORS AFFECTING USE OF MINIMUM TILLAGE FOR CORN. *Agron. J.* 54: 447-450. 1962.

Corn yield was compared for minimum and conventional tillage practices performed on unreplicated paired plots in Ohio in 1959-60 and in replicated plots in 1953-58. All cultural, soil and climatic factors were identical for each pair of treatments. Under conditions of equal plant populations within each pair of treatments, the following results were obtained: (1) As corn yield obtained with the conventional tillage procedures increased from 50 to 150 bushels per acre, the yield difference between tillage treatments (Δy) decreased from 8 bushels in favor of minimum tillage to 2 bushels in favor of conventional tillage; (2) in years with "low" rainfall on plots with slopes of 3 percent or more the difference in yield between minimum and conventional tillage was 14.6 bushels per acre greater than in years with "adequate" rainfall on the same slopes; (3) weed control practices, conventional seedbed preparation, soil surface texture and internal drainage, and previous crop did not alter the mean difference in yield of 4.8 bushels per acre between the two tillage systems; and (4) the mean yield advantage of 4.8 bushels per acre for minimum tillage from 211 pairs of treatments was economically as great as the savings in time and power usually ascribed to minimum tillage.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Stickler, F. C. SEEDING DEPTH AND USE OF PRESS WHEELS AS FACTORS AFFECTING WINTER BARLEY AND WINTER WHEAT YIELDS IN KANSAS. Agron. J. 54: 492-494. 1962.

Trials were conducted in Kansas from 1959 through 1961 to determine the effect of various press wheel treatments on winter wheat and winter barley production and to determine if existing press wheel equipment would result in responses similar to those observed with tractor wheels.

Significant increases in wheat were obtained from the use of press wheels at Manhattan in 1960, but not in 1959 or 1961. Significant increases in barley production were obtained in 3 to 5 trials.

At Belleville in 1960, use of the 1" x 10" press wheel was mainly responsible for yield increases, while in the Manhattan 1960 wheat test and the Belleville 1961 barley tests, it was the 2" x 26" wheels. In the 1961 Newton barley test, both press wheels were needed for maximum grain production.

It was suggested that the specific effect of press wheels in increasing yields was a compaction-soil thermal conductivity interaction, and the more favorable moisture supply which resulted in a higher degree of hardening, less freezing, and less extreme temperature changes.

Kans. Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

McGinnies, W. J. EFFECT OF SEEDBED FIRING ON THE ESTABLISHMENT OF CRESTED WHEATGRASS SEEDLINGS. J. Range Mangt. 15: 230-234. 1962.

The effects of cultipacking, pre-packing (wheel-track planting), and post-packing (presswheel drilling) on the establishment of crested wheatgrass seedlings were evaluated at the Foothills Range near Fort Collins, Colo., and at Central Plains Experimental Range (CPER) near Nunn, Colo. Nordan crested wheatgrass was planted on areas not cultipacked, cultipacked once, and cultipacked three times. Significant increases in numbers of seedlings resulted from cultipacking at the Foothills and slight improvement at CPER.

Pre-packing improved seedling stands, but light and heavy wheel pressures caused little difference. Pre-packing was most effective on uncultipacked plots and least effective on heavily cultipacked plots.

Press-wheels of 2- and 4-inch width and dead weight pressures of 70 to 300 pounds were used for post-packing after seed placement. Post-packing generally improved seedling stands but less than pre-packing. When heavy pressures were applied to the 2-inch press-wheel, the wheel cut into the uncultipacked soil too deeply, placed the seed too deeply, and reduced seedling numbers.

Cultipacking and pre-packing provided a firm seedbed and permitted the depth bands on disc openers to work effectively. On loose seedbeds, depth bands frequently were not effective in accurately controlling planting depth and the seed was planted too deeply.

CRD, ARS, USDA, Fort Collins, Colo.

Beaty, E. R., and Giddens, J. EFFECT OF VARIOUS METHODS OF SEEDBED PREPARATION AND CULTIVATION ON YIELDS OF CORN GROWN FOLLOWING RYE. Agron J. 54: 431-432. 1962.

The effect of various seedbed and cultural treatments on corn yields following rye were studied for four years. Plowing and disking, disking, and planting with rye as a mulch produced comparable yields. Planting after the rye growth was mowed and removed or planting

in standing rye, significantly reduced corn yields. Corn yields were similar where weeds were controlled by cultivation or by hoeing, both treatments were superior to allowing weeds to grow.

It was concluded that corn can be produced satisfactorily following rye in the Georgia Piedmont with a minimum of seedbed preparation and cultivation if weeds are controlled.

U. Ga., Col. Agr. Expt. Sta., Athens, Ga.

Fenster, C. R., Hanway, D. G., and Burnside, O. C. EQUIPMENT FOR SUBSURFACE APPLICATION OF HERBICIDES IN FALLOW LAND. Weeds 10: 329-330. 1962.

A 7-foot V-plow was modified so herbicides could be sprayed beneath the soil surface in stubble mulch fallow operations. This permits the incorporation of volatile herbicides without destroying plant residues. Weed control is achieved by action of the 7-foot sweeps during the herbicide application and later by the incorporated herbicide.

Paper 1187, J. Series, Nebr. Agr. Expt. Sta., Lincoln, Nebr.

Fertility Requirements For Conservation Farming

Hallock, D. L. EFFECT OF TIME AND RATE OF FERTILIZER APPLICATION ON YIELD AND SEED-SIZE OF JUMBO RUNNER PEANUTS. Agron. J. 54: 428-430. 1962.

The effect of time and rate of fertilizer application on yield and seed size of Jumbo runner peanuts grown in southeastern Virginia were investigated over a 5-year period on two sandy soil types.

Application of all the fertilizer to the corn in a 2-year rotation of corn and peanuts rather than split equally between the crops gave the following responses: (1) A higher content of extra large seeds in peanuts; (2) less fruit drop-off before or at digging; (3) a higher content of mature seeds in peanuts, particularly on Galestown fs; and (4) increased average corn yields on Woodstown lfs.

Increased rates of fertilization depressed the percentage of large seeds in peanuts produced on the Galestown soil. Fruit drop-off was greater in most of the fertilized than nonfertilized plots on the Galestown soil. At both sites, the average peanut yields for the 5-year period were statistically similar at all rates and under both systems of fertilization.

The application of 25 pounds per acre of N at planting depressed seed size of peanuts in some cases.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

McKell, C. M., Jones, M. B., and Perrier, E. R. ROOT PRODUCTION AND ACCUMULATION OF ROOT MATERIAL ON FERTILIZED ANNUAL RANGE. Agron. J. 54: 459-461. 1962.

Annual rangeland plots treated for 4 consecutive years with 66.6 pounds per acre of P, 100 pounds per acre of N, 100 pounds of N plus 66.6 pounds of P, or with no fertilizer were studied to determine the amount of root material (macro-organic matter) produced and accumulated in response to the various fertilizer treatments. Root material was obtained from the top 24 inches of soil by using a hand-driven 2.37-inch diameter core sampler.

The total amount of root material produced was greatest on the plots receiving 100 pounds per acre of N. Production of root material on plots fertilized with 66.6 pounds per acre of P and on plots fertilized with a combination of P and N appeared to be greater than on nonfertilized plots. The amount of root material decreased with increasing depth and no accumulation of roots was found at any particular depth in response to fertilizer treatment.

U. Calif., Riverside, Calif.

Linscott, D. L., Fox, R. L., and Lipps, R. C. CORN ROOT DISTRIBUTION AND MOISTURE EXTRACTION IN RELATION TO NITROGEN FERTILIZATION AND SOIL PROPERTIES. *Agron. J.* 54: 185-189. 1962.

Root development and moisture utilization in a nitrogen-fertilized and unfertilized Thurman ls and a nitrogen-fertilized, irrigated Hastings sicl were studied. Root and soil-moisture samples were taken at 2-week intervals during the growing season. Additions of moisture to the Thurman soil were controlled during the last 60 days of the growing season by a ground cover of polyethylene film. Soil oxygen and temperature data were collected during and after the growing season.

Nitrogen-fertilized corn produced deeper and more extensive root systems during the early part of the growing season than did unfertilized corn. Root penetration, distribution, and dry weights were essentially the same in both nitrogen-fertilized and unfertilized Thurman ls soils at the end of the growing season. Roots penetrated to 71 inches in Thurman soils after September 12. High bulk density (1.76 at 5-6 feet) and poor nutrition may have limited root penetration. Maximum observed root penetration in the Hastings sicl soil was 65 inches.

Moisture utilization was related to root growth. The period of greatest moisture use occurred 45 to 65 days after planting. Water use during this period was more extensive in fertilized plots. In controlled-moisture plots, nitrogen-fertilized corn used the same amount of water (9 acre-inches) as did unfertilized corn. Efficiency of moisture use, as measured by grain production, was increased 1.4 times by application of fertilizer to the Thurman soils. It was concluded that good nitrogen nutrition, which resulted in increased root production, increased subsequent moisture utilization during a critical period of plant development prior to and during tasseling, and resulted in higher yields.

Oxygen concentrations of soil air in the Hastings profile varied with soil moisture, depth in the profile, and stage of growth of the corn crop. Lowest oxygen percentages (6 to 12) during the season occurred in the B horizon. Oxygen in soil air of the root zone was apparently replenished from two sources, the atmosphere aboveground and the pore space of the C horizon. After the growing season, oxygen percentages in the root zone returned to near normal atmospheric values. The large percentage of unfilled pores permitted ready diffusion of oxygen in Thurman ls. Oxygen levels did not fall below 19 percent.

Differences in rate of corn root development between the two experimental soils were in part attributed to differences in soil temperature.

ARS, USDA, Cornell U., Ithaca, N.Y.

Baird, B. L., Fitts, J. W., and Mason, D. D. THE RELATIONSHIP OF NITROGEN IN CORN LEAVES TO YIELD. *Soil Sci. Soc. Amer. Proc.* 26: 378-381. 1962.

The propriety of specifying rates of N fertilization by the use of the N content of the leaves of corn was evaluated.

Steep slopes of both curves relating yield and N content of corn leaves to rates of N fertilization were associated with high correlation coefficients for the former two variables. These correlation coefficients consistently decreased, often becoming negative, as the rates of N fertilization were increased.

An evaluation also was made of the percent N of corn leaves corresponding to the economic optimum yields and maximum yields of grain for the fertility experiments at 38 locations.

Even though there may be good correlation between yield and N in the leaves, N content of leaves was a poor indicator of the rate of N fertilization. This was true for both economic optimum and maximum yields. The use of the percent N in the leaf should be limited to the comparison of the effect of known factor variation under research conditions and not for the prediction of rates of fertilizer application.

Jr. Author, N.C. Agr. Expt. Sta., Raleigh, N.C.

McClure, G. W., Jr., and Hunter, A. S. INVESTIGATIONS OF AMMONIUM CHLORIDE AS A NITROGEN FERTILIZER FOR FORAGE CROPS AND CORN. *Agron. J.* 54: 443-447. 1962.

NH₄Cl as a nitrogen fertilizer was compared with (NH₄)₂SO₄ in four field experiments with grasses or grass-legume mixtures. Effects on yield and Cl and N content of forage, and pH and Cl content of soil were measured. In a fifth field experiment, with corn, effects of NH₄Cl, (NH₄)₂SO₄, and NH₄NO₃ on corn yield, soil pH, and Cl content were determined. In a greenhouse experiment with timothy, equivalent amounts of these salts were applied to the plant leaves and to the soil, and plant growth was measured.

Forage grasses responded well, in yield and N content, to NH₄Cl at rates of 75 and 150 lb. N per acre. At the 75-lb. N rate, similar yields were obtained from NH₄Cl and (NH₄)₂SO₄. At rates of 225 or 300 lb. N per acre, NH₄Cl depressed yields relative to (NH₄)₂SO₄ and killed some plants. The N contents of forages grown with NH₄Cl averaged 0.1 percent higher than that of those grown with (NH₄)₂SO₄. Yields of corn were neither increased or decreased by NH₄Cl or other sources of N rates of 50, 100, or 200 lb. N per acre. NH₄Cl at high rates was more toxic to timothy than (NH₄)₂SO₄ or NH₄NO₃, whether applied to plant leaves or soil.

Soil pH was depressed less by NH₄Cl than by equivalent (NH₄)₂SO₄. Under conditions of well-drained soil and a mild winter, nearly all Cl applied to soil was lost by leaching within 1 year. Losses by leaching were reduced by poor drainage or freezing of soils. In four field experiments, during a year after application, an over-all average of 80 percent of applied Cl was removed from the top 24 inches of soil.

Jr. Author, Pa. State U., University Park, Pa.

Butler, B. J., and Smith, M. R. ANHYDROUS AMMONIA LOSSES AND DISTRIBUTION IN TILLAGE APPLICATION. *Trans. ASAE* 5: 231-234, 239. 1962.

Studies were made of plowsole application of anhydrous ammonia in silty clay and silt loam soils at 3, 6, and 9-in. depths of plowing; with 2, 3, and 4-ft. lengths of hose trailed under the furrow slice, and lateral hose positions 0, 4, and 8 in. from the furrow landside. These tests showed low losses in general, and with less than 0.5 percent of losses at 6- and 9-in. plow depths with 3- and 4-ft. hose lengths and the hose trailing 4 and 8 in. from the furrow landside.

The best combination of factors is a plow depth of 6 in. or more, a hose length of 3 ft., and lateral hose position 4 to 8 in. from the furrow wall.

Studies were made of tandem-disk applications with 3-, 4-, and 5-in. disking depths. The tandem disk can be used on silty clay and silt loam soils to apply ammonia with losses under 3 percent, if the disking depth is 4 in. or more and the soil is left well leveled.

Ammonia distribution in the soil is excellent with both plow and tandem-disk applications, the lateral movement exceeding the vertical movement in both methods. Direction and amount of distribution can be varied by varying the point of release.

Ammonia application rates as high as 500 lb. per acre can be applied with reasonably low loss by using trailed hoses behind every moldboard plow bottom or every other rear disk blade on the tandem disk.

Approximately 90 percent of the ammonia loss occurring after plow or disk application occurs in the first 30 minutes, and 97 percent in the first hour.

If no ammonia can be seen escaping and no ammonia odor can be detected above the zone release, the losses from tillage application on silt and silty clay loam soils should be less than 1 percent.

U. Ill., Urbana, Ill.

Doll, E. C. EFFECTS OF FALL-APPLIED NITROGEN FERTILIZER AND WINTER RAINFALL ON YIELD OF WHEAT. *Agron. J.* 54: 471-473. 1962.

In experiments conducted for 4 years at Campbellsville and 3 years at Greenville, Ky., yields of wheat were lower when N was applied in the fall than when applied as a spring topdressing in 4 of the 7 experiments. In longtime rotation experiments, conducted for 25 years at Campbellsville, 26 years at Greenville, and 23 years at Princeton, trends in wheat yields were described by means of linear regressions. When yearly deviations of actual wheat yields from the yields calculated from the regression equation were correlated with winter rainfall (December + January + February), correlation coefficients (r) of -0.481 , -0.448 , and -0.450 , respectively, (all significant at 0.05 level) were obtained. Thus, 20 to 23 percent of the deviations from regression could be attributed to winter rainfall.

These results indicate that fall applications of N to winter wheat in Kentucky would not be so effective as spring topdressings, although small applications might be needed to establish a vigorous stand in the fall.

Yield levels obtained indicate that wheat yields in Kentucky could be markedly increased by use of sufficient N.

Mich. State U., East Lansing, Mich.

Swezey, A. W., and Turner, G. O. CROP EXPERIMENTS ON THE EFFECT OF 2-CHLORO-6-(TRICHLOROMETHYL) PYRIDINE FOR THE CONTROL OF NITRIFICATION OF AMMONIUM AND UREA FERTILIZERS. *Agron. J.* 54: 532-535. 1962.

Results of 6 experiments are reported where 2-chloro-6-(trichloromethyl) pyridine was used as an additive to several ammoniacal fertilizers and urea in the nitrogen fertilization of irrigated cotton, sweet corn, and sugar beets in California. Improved growth and yields were obtained with the chemically treated fertilizers. These results are interpreted as being due to inhibiting of the conversion of ammonium ion to nitrite ion by the apparent toxic action of the chemical against nitrifying bacteria.

2-chloro-6-(trichloromethyl) pyridine addition increased the efficiency of ammonium sulfate, anhydrous and aqueous ammonia, and urea as fertilizers for cotton, of ammonium sulfate and anhydrous ammonia for sweet corn, and of ammonium sulfate for sugar beets.

Soil textures varied from sandy loams to clays. In the sandy loams, loss of nitrogen from the root zones was attributed to leaching.

Dow Chemical Co., Seal Beach, Calif.

Alexander, C. W., and McCloud, D. E. INFLUENCE OF TIME AND RATE OF NITROGEN APPLICATION ON PRODUCTION AND BOTANICAL COMPOSITION OF FORAGE. *Agron. J.* 54: 521-522. 1962.

Several comparisons of grass nitrogen versus grass-legume systems including consideration of time and rate of application of nitrogen were studied during 1955 to 1958.

Orchardgrass-alfalfa consistently produced 2.5 tons per acre of dry matter and showed relatively little response to nitrogen fertilization at rates up to 160 pounds per acre. Only an April application of 80 pounds of N produced a significant increase in forage yield. Each of the 4 years, the alfalfa comprised 35% of the mixture regardless of nitrogen application.

Orchardgrass-ladino clover and tall fescue-ladino clover mixtures shifted in botanical composition from 17% legume to pure-grass. Initial yields of 1.9 tons per acre, obtained regardless of nitrogen fertilization, were maintained in later years only by applications of 160 pounds of nitrogen per acre.

Pure stands of orchardgrass and tall fescue yielded from 1.0 to 2.9 tons per acre with 0 to 360 pounds per acre of nitrogen. With split applications of 240 pounds or more of nitrogen, orchardgrass stands were markedly thinned offsetting any beneficial effects of the fertilizer. At least 80 pounds of nitrogen per acre were required to produce dry matter amounts equal to unfertilized orchardgrass-ladino clover and tall fescue-ladino clover, and 240 pounds were required to equal yields from unfertilized orchardgrass-alfalfa.

CRD, ARS, USDA, Beltsville, Md., 20705.

Basak, M. N., Sen, S. K., and Bhattacharjee, P. K. EFFECTS OF HIGH NITROGEN FERTILIZATION AND LODGING ON RICE YIELD. *Agron J.* 54: 477-480. 1962.

Effects of heavy nitrogen fertilization and lodging on rice yield were evaluated from experiments in farmers' fields and experimental stations. Where the crop did not lodge, nitrogen application gave high yields. The optimum yield was obtained with 100 pounds N per acre. The optimum yield was nearly three times of the average rice yield in India. Lodging drastically reduced the rate of nitrogen consumption and response and the eventual yield. The results of past experiments showed that lodging was one of the main causes for low rice yields in India.

Higher straw-grain ratio and unbalanced distribution of absorbed nitrogen between straw and grain in a lodged crop suggested that lodging primarily affected grain formation processes.

Soil-plant-water relations indicated that lodging was a physiological phenomenon rather than a varietal character. It originated from development of structural weakness in culm tissues and was caused by deeper submergence of plants during vegetative growth aided by high nitrogen concentration in soil.

No significant interaction was found between nitrogen application and spacing in a planting population ranging from 62.5 to 250 thousand plant hills per acre.

Dept. Agr. and Food Prod., Govt. West Bengal, Calcutta, India.

Yield and growth responses of peach trees receiving four commercial nitrogen fertilizers were investigated. Treatments at a rate of 40 pounds N per acre were applied 1 month before bloom, or 1 or 3 weeks after bloom. The nitrogen carriers were: (1) Nitrate of soda (NaNO_3 16%N); (2) ammonium nitrate (NH_4NO_3 33 1/3% N); (3) urea ($\text{CO}(\text{NH}_2)_2$ 45% N); and (4) urea- formaldehyde (reaction products of urea and formaldehyde 38%N). Check plots, 5, received no fertilizer. Data were collected over two seasons. The second year, the cooperating grower resumed his customary practice and all trees received nitrogen at a 32-lb per acre rate in February.

Effect of Source of Nitrogen on Productivity of Elberta Peach Trees ¹

Measure and Year	NaNO_3 1	NH_4NO_3 2	$\text{CO}(\text{NH}_2)_2$ 3	Urea Form 4	Check 5	Significant difference
Yield in Pounds						
1959	125.2	127.0	108.1	110.0	110.3	N. S.
1960	130.3a	135.0a	111.3a	69.4x	56.5x	1%
Yield in Number of Fruit						
1959	447	468	421	426	428	N. S.
1960	789a	788a	618a	264x	190x	1%
Terminal Growth (inches)						
1959	12.0	12.6a	11.4a	5.4x	3.5x	1%
1960	7.0a	7.4a	8.2a	10.8x	11.6x	1%
Density of Flower Buds (No. per inch)						
1959	.71a	.77a	.70a	.24x	.34x	1%
1960	.51a	.62a	.72a	1.39x	1.67x	1%
No. Flower Buds Per Terminal						
1959	9.2a	10.2a	8.5a	1.0x	1.0x	1%
1960	5.2a	6.5a	7.6a	15.0x	20.6x	1%

¹Data expressed in tree means; in any horizontal row means followed by the same letter do not differ significantly.

²Flower buds were not counted on the same terminals used for growth measurements.

The consistent difference observed between treatments 1, 2, 3 and treatments 4 and 5 was due to the nitrogen availability in the fertilizer. NaNO_3 , NH_4NO_3 , and $\text{CO}(\text{NH}_2)_2$ supply nitrogen in a form readily available for plant use. While the nitrogen in NH_4NO_3 and $\text{CO}(\text{NH}_2)_2$ is not initially as available as NaNO_3 nitrogen, particularly in cool soils, under the conditions of this experiment there were never any significant differences in response between them.

In contrast, Urea-form is a very stable carrier and produces nitrogen slowly. Results from its use were unsatisfactory, being only slightly better than no nitrogen.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark.

Cooil, B. J., Watanabe, Y., Fukunaga, E. T., and Nakata, S. RESPONSES TO PHOSPHATE IN COFFEE. Hawaii Agr. Expt. Sta. Tech. Prog. Rpt. 133, 8 pp. 1961.

Comparisons were made between coffee trees which received low phosphate and extra phosphate treatments over a period of 3 years. Nitrogen fertilizer was supplied in 4 applications each year in each treatment. Yield increases resulting from the extra phosphate were 20.4 percent, 30.1 percent, and 30.9 percent, respectively, for crops harvested 1, 2, and 3 years after beginning the treatments.

Leaf phosphorus concentrations varied with seasons and years, but were generally higher in the extra phosphate treatment after the first year. The highest phosphorus values and the most consistent differences in phosphate concentration between treatments were found during the February to April period in the second and third years of treatment. The highest leaf phosphorus values were found in the second year of treatment, whereas the highest yields were in the third year.

The phosphate treatments employed had little or no influence on leaf nitrogen values. Hawaii Agr. Expt. Sta., U. Hawaii, Honolulu, Hawaii.

Allmaras, R. R., and Black, C. A. RELATIVE VALUE OF CALCIUM METAPHOSPHATE AND SUPERPHOSPHATE AS SOURCES OF PHOSPHORUS FOR PLANTS ON DIFFERENT SOILS. Soil Sci. Soc. Amer. Proc. 26: 470-475. 1962.

Availability-coefficient ratios (ACR) of phosphorus in calcium metaphosphate (CMP) to phosphorus in concentrated superphosphate (CSP) applied to 11 soils were obtained from data on yields of phosphorus in plants in a greenhouse experiment. ACR values ranged from 0.61 to 1.25 and were lower for calcareous than for acid soils. The best index of ACR values was provided by the increase in orthophosphate in the soils as a result of addition of CMP and partial hydrolysis of the condensed phosphate it contains. The increase in orthophosphate was estimated by: (1) Adding different quantities of P as KH_2PO_4 to soil; (2) incubating the soil under the same conditions employed for CMP; (3) finding the increase in orthophosphate by isotopic dilution of P^{32}O_4 in the presence of $(\text{CH}_3)_4\text{N}^-$ resin; (4) plotting the observed increases in orthophosphate against the quantities of P added as KH_2PO_4 ; and (5) finding by interpolation in the plot of (4) the quantity of P added as KH_2PO_4 to which the observed increase in orthophosphate with CMP was equivalent. The relative increases in orthophosphate present in water extracts of the soils as a result of application of CMP or CSP provided a good index of ACR values in most soils but not in all. The gross movement of P from CMP into surrounding soil provided a relatively poor index of the ACR values. In soils treated with CMP, the P absorbed by plants comes mainly from the orthophosphate and not directly from the condensed phosphates.

SWCRD, ARS, USDA, Morris, Minn.

Dundas, J. SODIUM FOR SUGAR BEET IN BRITAIN. World Crops 14: 220-224. 1962.

Evidence of the superiority of sodium over potassium for sugar beet because of the mutually beneficial action of nitrogen and sodium on this crop, the herbicidal effects of sodium in the form of sprays of nitrate of soda, and the suitability of sodium for clay beet soils was presented.

The experimental evidence reviewed showed that: Sodium was the second most important nutrient element for sugar beets in Britain, being more important than potassium;

sodium generally gave much higher yield increases than potassium and was more consistent in effect from season to season; in the presence of ample sodium, potassium often gave little yield increase and its use in these circumstances was often unnecessary and uneconomic; nitrogen and sodium each increased the effect of the other and consequently maximum sugar beet yields were in general obtainable only in the presence of both ample nitrogen and ample sodium; owing to the sodium it contains, nitrate of soda spray was an effective post-emergence herbicide for sugar beet fields; and sodium was safely used on clayey beet soils.

Nitrate Corp. of Chile Ltd.

Freney, J. R., Barrow, N. J., and Spencer, K. A REVIEW OF CERTAIN ASPECTS OF SULPHUR AS A SOIL CONSTITUENT AND PLANT NUTRIENT. *Plant and Soil* 17: 295-308. 1962.

A review of the literature on sulfur as a soil constituent and a plant nutrient was presented.

126 references.

Div. Plant Indus. Commonwealth Sci., and Indus. Res. Organ., Canberra, Australia.

Terman, G. L., and DeMent, J. D. CROP RESPONSE TO CALCIUM POLYPHOSPHATE GLASS AND SOME OF ITS DEGRADATION PRODUCTS. *Agron. J.* 54: 433-437. 1962.

Crop response to concentrated superphosphate (CSP), calcium metaphosphate (CMP), and partially hydrolyzed calcium metaphosphate (HCMP) was determined in a series of greenhouse pot experiments. A calcium pyrophosphate and two calcium diammonium pyrophosphates, formed during hydrolysis and ammoniation of calcium metaphosphate, were also studied. Unlimed and limed acid soils and a calcareous soil were used for the experiments.

Initial crop response to P in CMP and pyrophosphate fertilizers, especially as coarse granules, in greenhouse pot tests was generally poorer than to CSP. Later, response became more alike, especially with fine materials.

Granular HCMP (14 or 18 percent of its P water soluble) was similar in effectiveness for oats to ammoniated CSP (57 percent of its P water soluble). CSP and ammoniated CSP decreased in availability with time of reaction with Hartsells fsl limed to pH 7.5, but availability of granular HCMP did not change appreciably with 3 and 6 months' reaction with this soil.

Two calcium diammonium pyrophosphates, $\text{Ca}(\text{NH}_4)_2\text{P}_2\text{O}_7 \cdot \text{H}_2\text{O}$ and $\text{Ca}_3(\text{NH}_4)_2(\text{P}_2\text{O}_7)_2 \cdot .6\text{H}_2\text{O}$, were similar to HCMP as sources of P. Calcium pyrophosphate ($\text{Ca}_2\text{P}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$) was only slightly available.

In a 7-day N uptake test the fine calcium diammonium pyrophosphates were equal to $(\text{NH}_4)_2\text{SO}_4$ as sources of N for oats. Granular reaction products of NH_3 and HCMP usually supplied less N to oats during this period.

Soils and Fert. Res. Br., Div. Agr. Devlpmt. TVA, Wilson Dam, Ala.

Jackson, D. I. THE EFFECTS OF CALCIUM AND OTHER MINERALS ON INCIDENCE OF BITTER PIT IN COX'S ORANGE APPLES. New Zeland J. Agr. Res. 5: 302-309. 1962.

Sprays containing calcium, magnesium, potassium, phosphorus, nitrogen, boron, iron, strontium, tungsten, and vanadium were tested for their effect upon bitter pit development in stored apples (Cox's Orange). Only calcium nitrate significantly altered the incidence of pit, both tree sprays and post-harvest fruit sprays of this compound reduced incidence of bitter pit consistently. Later sprays tended to be more effective than early ones, but the most effective treatment was calcium nitrate (6 lb./100 gals.) applied fortnightly throughout the season. No damage occurred, even at concentrations of 10 lb./100 gals.

Fruit Res. Div., Dept. Sci. and Indus. Res., Havelock North, New Zeland.

Hileman, L. H. CHEMICAL ANALYSIS OF BROILER LITTER. Ark. Farm. Res. 6(5): 12. 1962.

About 500,000 tons of manure were produced by Arkansas broilers in 1959. The average chemical analysis of the 199 samples received and analyzed showed, on a dry-weight basis: 28.86 percent moisture; 4.09 percent nitrogen (N); 3.36 percent phosphate (P_2O_5); and 2.41 percent potash (K_2O).

In the table, these percentages were converted to total pounds of plant food per ton of litter at 28.8 percent moisture. The table also shows the theoretical value of each nutrient and the total value per ton of material. Based on these figures, a ton of average broiler litter as it comes from the house would be valued at about \$12.00.

Applying 2 tons per acre of such average broiler litter would supply 117 pounds of nitrogen, 96 pounds of phosphate, and 77 pounds of potash.

Pounds and Value of Nutrients per Ton of Litter at 28.8 percent Moisture,
Based on 199 Samples

Nutrient	Pounds per ton	Cost per lb. ¹	Value per ton
		<u>Cents</u>	<u>Dollars</u>
N	58.3	11.5	6.70
P_2O_5	47.9	.08	3.83
K_2O	38.3	.05	1.91
Total value per ton			12.44

¹ Average cost of these nutrients when purchased as commercial fertilizer.

Ark., Expt. Sta., U. Ark., Fayetteville, Ark.

Rasmussen, C. R. PIG MANURE AS A SUBSTITUTE FOR HORSE MANURE IN MUSHROOM GROWING. In ADVANCES IN HORTICULTURAL SCIENCE AND THEIR APPLICATION. Proc. 15th International Hort. Cong., Nice, 1958. 1: 393-399. 1962.

Horse manure compost, synthetic compost, and pig manure compost were included in six comparative cropping experiments with growth media for mushroom cultures. Owing to

inexperience and the choice of unsuitable material, very low cropping yields were obtained from pig manure compost in the first experiments. With more experience and choice of more suitable pig manure in the following experiments, larger yields were obtained (considerably larger than from synthetic compost). In the fifth and sixth series of experiments yields from pig manure were even larger than those from horse manure.

Pig manure heats very easily but the piles shrink quickly and exclude the air with resulting anaerobic fermentation. Pig manure needs only small amounts of water during composting as compared with horse manure. The final product is much more greasy than horse manure compost. While normally 12-13 m.² (130 to 141 sq. ft.) of beds are filled per ton of fresh horse manure only about 8 m.² (86 sq. ft.) were filled per ton of fresh pig manure. Peak-heating (pasteurization) of the compost before laying down the mushroom mycelium was needed to obtain good crop yields.

Mushroom Res. Sta., The Royal Vet. and Agr. Col., Copenhagen, Denmark.

Eby, H. J. MANURE LAGOONS... DESIGN CRITERIA AND MANAGEMENT. Agr. Engin. 43: 698-701, 714-716. 1962.

Confinement housing of livestock and poultry with a corresponding decrease in land areas available have combined to compound the problem of manure disposal.

One solution to this problem has been the manure-disposal lagoon which within its limitations does a satisfactory job. It has obvious limitations such as non-availability of land, land too porous, sufficient water not available, and undesirable underground water movements.

Lagoon loading recommendations, due to the absence of any other criteria, have been based on the loading recommendation for municipal sewage-disposal lagoons as published by the different states. These may be modified or liberalized for farm use.

In selecting a site for a lagoon the following should be considered: Soil percolation rate; possibility of contamination of wells; availability and cost of land; topography of land; direction of prevailing wind; proximity of lagoon to animals being served; and need for diversion dams and/or ditches.

The process by which a lagoon works is a natural symbiosis of algae and bacteria in a balance between physical, chemical, and biological conditions. There is no geographical limitations upon where lagoons may be constructed.

Lagoons may be designed on a volumetric basis in that one cubic foot of water will dispose of 0.01 lb. of manure per day.

Lagoons may also be designed on a surface-area basis using the population equivalent values as shown on Table below. These values may be considerably liberalized by the various states for farm use.

In operating a lagoon the following should be considered: (1) Avoid floating material of any kind (including hydrocarbons), as this interferes with both the surface absorption of oxygen from the air and restricts light to the algae for photosynthesis. (2) Avoid overloading. This results in an anaerobic condition that is odorous and unsightly. When large quantities of material over a short period of time are to be disposed of, add gradually over several days to prevent overloading. (3) Avoid intermittent loading. This changes the micro-organism population and lowers efficiency of the lagoon. (4) Keep weeds at the lagoon edge mowed so as to help keep down the mosquito and rodent population. And (5) in a properly constructed and managed lagoon sludge buildup is of minor consideration.

TABLE. Lagoon Loading Rates

Item	PE*	Load factors +				
		100	150	200	250	300
Man	1.00	100	150	200	250	300
Horses	11.30	8.7	13.2	17.7	22.1	26.5
Cows	16.40	6.1	9.2	12.2	15.2	18.3
Sheep	2.45	40.1	60.1	80.2	100	120.2
Hogs	1.90	50.3	70.9	100.6	132	150.8
Chicken	.014	7000	10500	14000	17500	21000

Note: The figures in this table give values that will assure complete oxidation assuming that fresh material is fed into the lagoon.

*Population equivalent, from "Waste Disposal Feasibility" study at the new animal farm of the National Institutes of Health, John M. Henderson, special consultant.

+Population serviced per acre of lagoon surface area.

AERD, ARS, USDA, College Park, Md.

Salinity and Alkali Problems

Carter, D. L. A BIBLIOGRAPHY OF PUBLICATIONS IN THE FIELD OF SALINE AND SODIC SOILS THROUGH 1961. U.S. Dept. Agr., Agr. Res. Serv. ARS 4I-80, 47 pp. 1962.

This bibliography resulted from a systematic search and review of the literature concerning saline and sodic soils. The papers are grouped under various headings which necessitated listing a small number of the references more than once.

This bibliography does not include all papers published on the subject of saline and sodic soils. Many foreign papers are not included, since access to extensive foreign literature was limited.

ARS, USDA, Inform. Div., Room 645 A, FCB, Hyattsville, Md., 20781.

Puri, B. R., and Mahajan, O. P. EFFECT OF ADDING CHARCOAL ON THE MOISTURE-RETENTION CAPACITY OF SOIL. Soil Sci. 94: 162-167. 1962.

The effect of adding charcoal on the moisture retention capacity of soil was studied by mixing together soils and charcoals of different homoionic contents. The results were satisfactory on the basis of a mutual exchange of cations at the two surfaces. The addition of H-charcoal or Ca-charcoal to Na-soil--a practice recommended for the amelioration of alkali soils--resulted in a considerable increase in the moisture sorption capacity of the soil.

Panjab U., Chandigah, India.

Luken, H. SALINE SOILS UNDER DRYLAND AGRICULTURE IN SOUTHEASTERN SASKATCHEWAN (CANADA) AND POSSIBILITIES FOR THEIR IMPROVEMENT: I. DISTRIBUTION AND COMPOSITION OF WATER-SOLUBLE SALTS IN SOILS IN RELATION TO PHYSIOGRAPHIC FEATURES AND PLANT GROWTH. *Plant and Soil*. 17: 1-25. 1962.

Soil salinization in some areas of southeastern Saskatchewan was discussed from the standpoint of its occurrence in relation to climatic conditions, soil type, topography, and land use.

Accumulations of salts resulted from temporary water tables and the capillary movement of water upwards and its subsequent evaporation. Maximum concentrations of salts occurred on the soil surface or in deeper soil layers, depending on the location of the profile with respect to the topographical contour. Salt leaching on the slope was reduced because of water run-off, but was high in the depression due to water accumulation.

A comparison between grassland and cultivated land showed a favorable influence of grass on the reduction of surface salinization. These favorable effects may be related to the influence of the vegetational cover on water run-off and water evaporation. It was concluded that the increase in cultivated land over the years at the expense of grassland and also the summer fallowing practice are contributing factors towards the spreading of soil salinization.

Analytical data from saturated extracts are discussed from the viewpoint of concentration and composition. All test locations showed a preponderance of Mg- and SO_4 -ions in the salinized samples. SSP values did not exceed 30 percent. The influence of varying concentrations of these salts on the yields of three cereal crops was tested. The sequence of salt tolerance of barley, wheat, and oats in decreasing order was identical with results reported elsewhere from irrigated plots. Absolute salt concentrations effecting a 50 percent yield decrease, however, were considerably lower. This was attributed to differences in the environment.

Canada Dept. Agr., Indian Head, Saskatchewan, Canada.

Luken, H. SALINE SOILS UNDER DRYLAND AGRICULTURE IN SOUTHEASTERN SASKATCHEWAN (CANADA) AND POSSIBILITIES FOR THEIR IMPROVEMENT: II. EVALUATION OF EFFECTS OF VARIOUS TREATMENTS ON SOIL SALINITY AND CROP YIELD. *Plant and Soil*. 17: 26-48. 1962.

Yields of wheat, when grown on saline soil under dryland conditions were increased by treatments such as mulch, manure, high rates of nitrogen and phosphorus fertilizers in combination or alone, and by Krilium. On the other hand, all treatments, with the exception of Krilium, had no effect on the salinity concentrations of the 0-6 inch soil layer. All three factors, namely fertility improvement, structure improvement, and moisture preservation contributed towards higher yields on saline soil. The return decreased with increased salinity. This reduction in responsiveness was ascribed mainly to a reduction in the availability of nutrients to plants when grown on saline soils.

An investigation into the water--salinity--plant-growth relationship showed that the summer fallow method favors salt accumulation in the soil surface horizon. Evaporation from the bare soil surface was lower on saline than on nonsaline soils which will lead to an accelerated salinization due to prolonged capillary flow. The water-use efficiencies of plants decreased with increasing salinity and, in relation to phosphorus levels, varied proportionately to the amounts of green weights produced.

Mean yields and mean salinities markedly changed during the course of the experiment as the result of climatic conditions. Variations in ionic composition of soil solutions as the result of their concentrations were evidenced, but these were not effected by the treatments.

Determinations of germination, rate of emergence, and thousand-kernel weights of wheat in relation to salinity and treatments provided additional information.

Canada Dept. Agr., Indian Head, Saskatchewan, Canada.

Luken, H. SALINE SOILS UNDER DRYLAND AGRICULTURE IN SOUTHEASTERN SASKATCHEWAN (CANADA) AND POSSIBILITIES FOR THEIR IMPROVEMENT: III. INFLUENCE OF ORGANIC MATTER APPLICATIONS ON SOIL SALINITY AND CROP YIELDS. Plant and Soil. 17: 49-67. 1962.

The effects of organic matter applications on saline soils and crop yields were studied in a growth room and in the field.

In the growth room, peat incorporations improved the yields of barley (fresh weight) over the full range from non-saline to highly saline soils, providing the peat-induced moisture stresses in the mixtures were compensated by additional water application ("F.C.") Where peat was applied without additional water ("Stress"), the yields of barley were only improved where the salinity was high. The relative yield reductions due to salinity were less in the peat-treated soils at both water levels than in the control soils.

In the field, high rates of manure applications to saline soils resulted in substantial salinity reductions during the first year. Yield improvements persisted over the 3 years and were still twice as high at the end of the experiment, although the control plot had reached the same salinity level as the treated plot due to natural leaching.

It was concluded that the ameliorative value of organic matter on saline soils was based on the following factors:

1. The mixing of non-saline organic matter with saline soils caused a reduction of the original salinity concentration. Where manure was applied, the mixing effect was gradually diminished as the result of organic matter decomposition.
2. The increase in the moisture-holding capacity and available moisture of the peat-treated soils where a dilution of the salt concentration in the soil solution and an increase in available moisture for plant growth was effected in the F. C. watering levels.
3. The reduction of Na-concentrations in the surface soil of the manure-treated plots may be related to structural soil improvement with additional leaching.
4. The improvement in plant nutrition, particularly in the manure-treated plots. The conductivities of the saturation extracts gave the highest correlation coefficient with yields of barley in the growth room experiment. This is attributed to the direct relationship between the saturation percentage and the field-moisture range.

The economy of water use by evapotranspiration was most profitable at low and medium salinities in the peat-treated soils. The favorable influence of peat was ascribed to the change in the moisture-holding capacity of the soil-peat mixtures. The Stress treatments, when compared to the F.C. water levels, were detrimental to the fresh weight production of barley per unit water loss by evapotranspiration.

Canada Dept. Agr., Indian Head, Saskatchewan, Canada.

Haas, R. H., Morton, H. L., and Torell, P. J. Influence of soil salinity and 2,4-D TREATMENTS ON ESTABLISHMENT OF DESERT WHEATGRASS AND CONTROL OF HALOGETON AND OTHER ANNUAL WEEDS. J. Range Mangt. 15: 205-210. 1962.

The effects of soil salinity and the control of annual weeds on the establishment of desert wheatgrass were studied on artificially salinized plots. Four soil salinity levels were created on a medium-textured soil by adding sodium chloride at rates of 0, 20, 40, and 80 pounds per 1.5 square rods before seeding desert wheatgrass. The salinity conditions ranged from non-saline to a salinity level which would permit growth of only salt-tolerant species. The pH of the soil was unchanged at the several levels of salinity.

Halogeton was more tolerant to soil salinity than Russian thistle or desert wheatgrass. Russian thistle was more readily suppressed by competing vegetation than was halogeton.

In the fourth growing season, halogeton occurred in inverse proportion with desert wheatgrass; but, when the influence of the grass density was removed, significantly more halogeton occurred at the higher salinity levels.

The removal of annual weeds by the use of 2,4-D in the establishment year did not significantly increase the number of desert wheatgrass plants established in 1957. Two years later, the ground cover of desert wheatgrass on the sprayed plots was more than twice that of plants on the unsprayed plot and the yield of desert wheatgrass was significantly greater on sprayed than on unsprayed plots. Favorable establishment conditions had a long-term influence on the yield potential of this desert wheatgrass planting.

Decreased desert wheatgrass yields due to increased soil salinity were attributed to both stand reduction and lower yields per individual grass plant. Desert wheatgrass yields were decreased approximately 58 and 77 pounds per acre for each 0.1 percent increase in soluble salts in 1958 and 1959, respectively.

Tex. Agr. Expt. Sta., College Station, Tex.

Carter, D. L., and Peterson, H. B. SODIC TOLERANCE OF TALL WHEATGRASS. Agron. J. 54: 382-384. 1962.

Tall wheatgrass grew and produced well at ESP (exchangeable-sodium-percentage) levels between 50 and 60 under field conditions. In the greenhouse, tall wheatgrass germinated and produced at ESP levels of 60, with transplants exhibiting superior performance. Seeds germinated with no adverse effects at pH levels up to 9.7. Plants grew at pH levels of 10.0 in solution culture.

SWCRD, ARS, USDA, Weslaco, Tex., 78596.

Clark, H. L., and Juve, R. L. EFFECTS OF SALINE WATER FROM HURRICANE "AUDREY" ON SOILS. Agron. J. 54: 390-392. 1962.

Inundation by salt water from Hurricane "Audrey" strongly affected the salinity of most soils. Salt marsh range soils and permeable ridge soils were least affected. Fresh marsh soils and slowly permeable ridge soils were most affected. The storm-caused salinity decreased significantly for 14 months where the soils were not subject to salt water tides. Prestorm level of production of vegetation on areas studied was reached within two growing seasons.

SCS, USDA, Crowley, La.

Cover Crops and Green Manure Crops

Morgan, G. W., and Hanna, W. J. EFFECT OF A RYE WINTER COVER CROP ON SOIL FERTILITY AND ON THE SUCCEEDING SWEET CORN CROP. *Agron. J.* 54: 396-399. 1962.

Some of the effects of a rye winter cover crop, managed in several ways, on soil fertility and on a succeeding sweet corn crop were investigated on a Nixon s1 soil. Fertilizer applied early in the spring produced a larger rye cover crop with higher amounts of N, P, and K than rye receiving the same fertilizer in the fall, or unfertilized rye. Fall-fertilized rye yielded more and contained more nutrients than unfertilized rye.

Turning under a rye cover crop, fertilized or not, did not, during the following 3 months, improve the $\text{NO}_3\text{-N}$, P, or K level of the soil over soil without rye cover. Yield and N, P, and K content of a succeeding sweet corn crop were likewise not affected.

Small grain winter cover crops for erosion control and for green manure may be worthwhile in vegetable-growing areas of the Atlantic coastal plain over the rotation period. The fertilization of these cover crops in the fall or early spring to increase their growth and to serve as a means of storing nutrients for use by the succeeding cash crop was economically doubtful in this study.

A minimum of 2 percent N in rye tops appears to be the critical level for a good-quality rye green manure crop.

Jr. Author, N.J. Agr. Expt. Sta., Rutgers, The State U., New Brunswick, N.J.

Climatic Influences

Stout, G. E., and Huff, F. A. STUDIES OF SEVERE RAINSTORMS IN ILLINOIS. *J. Hydraul. Div., ASCE* 88 (HY 4): 129-146. July 1962.

A brief outline of various studies concerning the time and space distribution of severe rainstorms in Illinois was presented. Most of the studies present results that should be approximately representative of conditions in the Midwest.

Area-depth studies, based on data from four rain-gage networks, indicated little difference in the characteristics of storm area-depth curves throughout Illinois. Warm-season curves had a considerably greater slope than cold-season curves. Shower-type rainfall produced greater relative variability and steeper curves than steady-type precipitation.

A study of the distribution of heavy rainstorms over an urban area of 10 sq. miles showed that a point-rainfall record was a satisfactory index of the frequency distribution of areal mean rainfall. The majority of the excessive quantities for storm periods of from 30 min. to 24 hr. occur in the same storms.

Field surveys of major flood-producing storms since 1948 demonstrated the need of investigations to evaluate accurately the time and space distribution of rainfall in these storms, particularly with respect to maximum rainfall at the storm center. They have shown that 24-hr. storms with quantities exceeding 10 in. are not rare occurrences in Illinois, although these storm centers are seldom detected by the hydroclimatic network in the State.

Studies of the orientation and shape of severe rainstorms indicated that approximately 70 percent of these storms are oriented within the sector from 235° to 295° , and 30 per-

cent from 235° to 255°. Shape analyses of storms with durations to 72 hr. indicated that the general storm pattern was represented best by an ellipse. The ratio of major to minor axis of isohyets (shape factor) tended to increase in proceeding outward from the storm center. No significant difference was found in the shape factor with increasing storm magnitude and with increasing storm duration, other factors remaining constant.

Analyses of radar and synoptic weather data collected in conjunction with widespread, severe rainstorms indicated that these storms usually occur in a quasi-stationary instability zone that is often associated with a quasi-stationary front with waves in the storm region. A statistical study of the frequency distribution of weather fronts in Illinois has shown that the region of most frequent stagnation of fronts in the state corresponds closely with the region of most frequent occurrence of severe rainstorms.

Ill. State Water Survey, Urbana, Ill.

Paauw, F. Van Der. EFFECT OF WINTER RAINFALL ON THE AMOUNT OF NITROGEN AVAILABLE TO CROPS. *Plant and Soil*. 16: 361-380. 1962.

Relations between rainfall during the winter and crop response to nitrogen were studied. Two experimental fields were started in 1947 and both were cropped annually with potatoes-rye-oats grown in rotation, and a range of nitrogen dressings applied to the soils. In order to avoid cumulative effects the amounts applied to any plot were changed each year. Small residual effects of nitrogen supplied in the preceding year were determined and eliminated statistically.

A clear negative correlation was found between the sum of rainfall in winter (November to February) and the yields of rye grown without nitrogen dressing. The depressions of yields occurring after wet winters could be eliminated by supplying additional amounts of nitrogen. Decrease of fertilization could prevent lodging and yield depression after dry winters.

The results with winter rye were confirmed by those with oats grown in the spring.

The correlations found with potatoes were weaker probably due to a more pronounced influence of the weather during the summer on the nitrogen response than is the case with cereals.

These correlations were attributed to losses of nitrogen during winter. This was confirmed by varying the amount of rainfall by partially intercepting it with glass during showers and determining the nitrogen response at both the actual and reduced winter rainfall levels. The response to nitrogen dressing was considerably lower after interception of relative small amounts of rainfall. On different soils the effect of 1 mm. (0.4 in.) additional rainfall in relatively dry winters equaled that of 0.25 to 1.25 kg. nitrogen per hectare (.5 to 2.7 lbs. nitrogen per acre).

The effect of interception was found to be smaller after dry winters when leaching was slight, and also after very wet ones when almost all available nitrogen had been leached deeply in the subsoil.

Soluble nitrogen was determined in different soil layers. It was demonstrated that differences in nitrogen response after partial interception of rainfall were principally due to different leaching and distribution of nitrogen in the subsoil.

Inst. Soil Fertility, Groningen, The Netherlands.

Paauw, F. Van Der. PERIODIC FLUCTUATIONS OF SOIL FERTILITY, CROP YIELDS AND OF RESPONSES TO FERTILIZATION EFFECTED BY ALTERNATING PERIODS OF LOW OR HIGH RAINFALL. *Plant and Soil* 17: 155-182. 1962.

The phenomenon of cyclic fluctuation of factors is common in meteorological literature. More or less cyclic alternations of periods of different rainfall appear to be especially evident from 1910 to the present day and also from 1854 to 1879.

The soil fertility status is related to the prevailing weather conditions. Changes in the amount of precipitation give rise to considerable changes in the fertility of the soil.

Periodic fluctuations of soil factors such as the contents of water-soluble phosphorus, exchangeable potassium, and the pH originate from gradual and cumulative effects of rainfall in alternating periods of markedly different precipitation. The contents of phosphorus and potassium rise in dry and fall in wet periods, the pH (of soil in water suspension) reacts in the opposite sense.

Periodic responses of crop yields to the application of phosphorus dressings opposite in sense to the periodic fluctuations of the content of water-soluble phosphorus (being large if content is low) have been observed.

Periodic responses of crop yields to the application of phosphorus dressings opposite pH.

Similarly periodic responses to nitrogen dressing are found on soils with a poor production of available nitrogen. Obviously the amount of available nitrogen is affected by alternating rainfall periods though the effect of winter rainfall on nitrogen response is paramount in most cases.

The differences noted in the content of exchangeable potassium in grassland are considerable and surpass those effected by different fertilizer practices.

Distinct periodic fluctuations of crop yield, which have been observed frequently with many crops on a variety of soils in practical farming and on experimental fields, must be attributed to periodic fluctuations of soil fertility. In their turn the latter are controlled by the alternation of periods of different rainfall. The pattern of these alternations is rather similar in adjacent districts and only slowly changes from north to south and from east to west in the Netherlands.

A similar pattern of rainfall to that observed in the Netherlands was apparent between 1844 and 1893 in England. The course of yields of wheat grown continuously on the Braodbalk field of Rothamsted Experimental Station closely corresponds to this distribution of rainfall.

The response of yield to the alternating rainfall periods is economically important. The average yields of wheat and rye in Dutch provinces after some dry years amount to $1\frac{1}{2}$ times of those obtained after a succession of wet years. Similarly the yield of a more sensitive crop like peas is about 3 times higher. Over smaller areas especially on infertile soil these differences may be still larger.

Since the fluctuations of crops yields may be ascribed to changes of the actual soil fertility status, it seems possible to forecast yields on the basis of the determination of the deviations of soil factors from the normal trend.

Inst. Soil Fertility, Groninger, The Netherlands.

Weakly, H. E. HISTORY OF DROUGHT IN NEBRASKA. *J. Soil and Water Conserv.* 17: 271-273, 275. 1962.

Records of weather measurements do not cover a very great span of time in the United States. The maintenance of official records was first authorized in 1870 by an act of Congress, which required that weather records be kept at all military posts. A large proportion of the continuous records now available span less than 75 years, although some continuous records of the weather have been kept for 100 years.

Continuous weather records in Nebraska were started in 1850. In Western Nebraska, the earliest records available were made in 1865.

Among the natural records that rank high as indicators of past climatic conditions are the annual growth rings of trees.

The relatively long tree ring records of alternate periods of drought and of more favorable rainfall conditions in the Great Plains are of great value as a means of interpreting the factors that may have been instrumental in causing the various changes in occupation of the area by man. This is especially true of the later prehistoric periods.

Tree ring records present a definite picture of recurring climatic phenomena that may offer a clue to probable future climatic patterns.

The first consideration in the use of dendrochronology in a study of climate is the construction of a good, dependable master chart.

The tree ring chronology for Western Nebraska at present extends back to the year 1210 in a continuous dated sequence from an archeological site in Ash Hollow. This same site also provides four additional floating or undated chronologies extending backward from some time prior to 1210. Taken together these chronologies provide a record of 588 years, and if the gaps between them could be bridged, there would be an unbroken record extending into the centuries before Christ.

TABLE. Periods of drought of 5 or more year's duration, of each drought and number of years duration of each drought and number of years between each drought for a period of 748 years at Ash Hollow, Garden County, Nebr.

First year	Last year	Duration of drought years	Years between droughts
1220	1231	12	29
1260	1272	13	3
1276	1313	38	33
1383	1388	6	16
1438	1455	18	38
1493	1498	6	13
1512	1529	18	10
1539	1564	26	23
1587	1605	19	20
1626	1630	5	38
1668	1675	8	13
1688	1707	20	21
1728	1732	5	29
1761	1773	13	26
1798	1803	6	25
1822	1832	11	25
1858	1866	9	18
1884	1895	12	10
1906	1913	8	17
1931	1940	10	11
1952	1957	6	23.9
Average		12.8	

SWCRD, ARS, USDA, Lincoln, Nebr.

Smith, F. L., and Pryor, R. H. EFFECTS OF MAXIMUM TEMPERATURE AND AGE ON FLOWERING AND SEED PRODUCTION IN THREE BEAN VARIETIES. *Hilgardia* 33(12): 669-688. 1962.

Statistical studies on five bean varieties, California Red, Sutter Pink, Pinto, Red Kidney, and Small White, planted at 2-week intervals from late May to late July over a 4-year period indicated that yields increased up to mid-June, remained high through mid-July, and then declined in late July for four of the five varieties. The exception was Small White which did not mature in the mid-July planting some years and never in late-July plantings. Significant differences were obtained in varietal yields.

Correlation studies of data from tagged flowers on three varieties over a three-year period were made.

Significant positive correlations were obtained between percent set and beans per pod in all varieties.

Significant negative correlations were obtained between age of plants and percent set, and age of plants and beans per pod in all varieties.

Significant negative correlations were obtained between percent set and maximum temperatures the day before, the day of, and the day after bloom in Small White and Sutter Pink. In California Red these correlations were too low to be significant.

The negative correlations between maximum temperature and beans per pod were smaller than between maximum temperature and percent set, and only in Sutter Pink were they significant. Beans per pod in California Red were not affected by temperature.

California Red gave the highest yields, highest percent set, and highest beans per pod. Sutter Pink ranked second and Small White third.

Advancing age of plants was more effective in reducing percent set than were increasing temperatures.

Agr. Pub., Room 207 U. Hall, 2200 U. Ave., Berkeley, Calif.

Splittstoesser, W. E., and Derscheid, L. A. EFFECTS OF ENVIRONMENT UPON HERBICIDES APPLIED PREEMERGENCE. *Weeds* 10: 304-307. 1962.

Experiments were conducted for a 2-year period in the greenhouse and for a 6-year period in the field to determine the effect of rainfall upon the control of foxtail with various rates of three chemicals. Simulated rainfall was applied to greenhouse flats at various times ranging from 7 days before application of the simazine or atrazine to as late as 21 days after application. Natural rainfall received in the field experiments was correlated with results obtained from application of CDAA, atrazine, and simazine. The following conclusions were made:

1. Water moved CDAA, atrazine, and simazine into the soil. It leached the herbicide into dry soil but the herbicide movement was along a concentration gradient in wet soil.
2. Preemergence applications of 4 to 6 lb./A. of CDAA controlled foxtail effectively in South Dakota if applied to warm soil and if normal amounts of rain fell within 7 to 10 days. The effectiveness of sprays was reduced if applied to wet soil, if less than $\frac{1}{2}$ inch of rain fell the first week after application, or if a heavy rain fell immediately after application. Granules were effective under similar conditions, but this effectiveness was not impaired by application to wet soil or by heavy rain immediately after treatment.

3. Preemergence application of 2 to 4 lb./A. simazine as sprays or granules controlled foxtail in South Dakota if applied to wet soil, if 1 inch of rain fell within 15 days after application, or if 3/4 inch of rain fell during each of 2 weeks after treatment. Fair to good results were obtained when 1 inch fell during the third week. Under these rainfall conditions weed control was maintained all summer by 4 lb./A. but larger amounts of rain shortened the period of weed control.
4. Rates of 3 to 4 lb./A. of atrazine controlled foxtail in South Dakota if 1/2 to 1 inch of rain fell within 15 to 20 days after application. The period of residual weed control was shorter than for simazine and was reduced to a greater extent by heavy rainfall.
5. Mechanical incorporation was not a substitute for rainfall, but aided in the activation of simazine if soil moisture or rainfall was slightly below the minimum required to activate it.
6. Simazine moved downward in the soil very slowly.
7. Small grain was severely damaged when planted the year after application of 2 lb./A. of atrazine or simazine, but was not injured by residues from as much of 6 lb./A. of CDAA.

S. Dak. State Col., Brookings, S. Dak.

Surface Soil Removal

Eck, H. V., and Ford, R. H. RESTORING PRODUCTIVITY ON EXPOSED SUBSOILS. J. Soil and Water Conserv. 17: 274-275. 1962.

When moisture conservation practices such as bench leveling, land leveling, or similar land forming operations are employed, topsoil is removed and the subsoil is exposed.

The productivity of three fine sandy loam soils--Amarillo, Dalhart, and Miles--was studied in greenhouse and laboratory experiments at Bushland, Tex., to study the effects of topsoil removal and subsoil exposure. All three soils are deep, moderately permeable, and well drained.

The results show that the subsurface horizons of some soils can be more productive than the topsoil. Fertilizer can be used to compensate for the loss of topsoil. If fertilizer is applied, rather deep cuts may be made on these soils without impairing yield potentials. The yields obtained on the mixture of horizons of Dalhart soil show that mixing some surface soil with the subsoil may enhance productivity. Deep plowing to bring finer textured soil material to the surface for control of wind erosion was not detrimental to productivity.

The effect of topsoil removal on crop yields is dependent upon the physical as well as the chemical properties of individual soil profiles. The soils involved in this study were all deep and permeable. The physical conditions of the subsoils were satisfactory for tilth, and topsoil removal was not greatly detrimental to the soil-water reservoirs. The effects of topsoil loss should be determined before any topsoil is removed from productive lands.

Amarillo, Dalhart, and Miles soils, which comprize large areas in the Southern Great Plains, are amenable to land-forming practices that require topsoil removal. Topsoil loss, readily compensated for by the application of both nitrogen and phosphorous fertilizers, can be sacrificed for benefits obtained from moisture conserving practices.

SWCRD, ARS, USDA, Bushland, Texas.

Mulching

Judkins, W. P. SAWDUST AS A MULCH. Agr. Ext. Serv., Va. Polytech. Inst., C. 650, 8 pp. Rev. 1960..

Sawdust is an excellent material to use as a mulch for the vegetable and flower garden, and for strawberry plants, berry bushes, and shrubs. Sawdust is easy to get in many communities.

The following advantages result from the use of sawdust as mulch: (1) It reduces the crusting of soil and improves the germination of seed and the emergence of the young plant; (2) it conserves moisture and keeps the soil cool during the hot summer months; (3) it helps rain water move into the soil; (4) weeds are easier to control; (5) the yield of the crop is increased and the quality is improved; and (6) vegetables and flowers may be harvested immediately after a rainstorm without the gardner having to walk on muddy ground. The following benefits are secured when sawdust is plowed into the soil after it has served as a mulch: (1) Heavy soils will become lighter and easier to work; (2) light soils will have a higher water-holding capacity; and (3) when the sawdust has decomposed into humus, it increases the nutrient-holding ability of the soil. Additional items to remember about sawdust mulches are: (1) Sawdust will not make the soil acid; (2) sawdust is not toxic to plants; (3) either hardwood or softwood sawdust may be used; (4) fresh sawdust is as good or better than old sawdust; and (5) adequate fertilizer should be used to avoid nitrogen deficiency.

Va. Polytech. Inst., Agr. Ext. Serv., Blacksburg, Va.

Moody, J. E., Lillard, J. H., and Jones, J. N., Jr. STRAW MULCH WILL BOOST CORN YIELD. Crops and Soils 14(8): 27. 1962.

Three tons of wheat straw per acre as a surface mulch increased corn yields in a 3-year study at Virginia.

These surface-mulched plots were compared with plots where wheat straw was plowed under. Nitrogen fertilizer was used at rates of 75 and 175 pounds of N per acre; other nutrients, including phosphorus and potassium, and soil pH were at adequate levels. Herbicides were used to control weeds and corn was not cultivated.

The effects of mulch on soil temperature and soil moisture were the major factors influencing growth and yield of corn. There were no significant effects from higher nitrogen application.

Early season growth of mulched corn was delayed in 2 years of the experiment because of the cooler soil under the mulch. Soil temperatures at the 4-inch depth in May and June averaged 2 to 3 degrees F. lower under mulch than under bare surface plots. When planting was delayed 3 weeks past normal planting time, this temperature effect on early growth under mulch conditions was eliminated.

Beginning in late June, there was a sharp increase in growth of mulched corn compared with bare surface plots. Mulched corn was about 2 feet taller at tasseling and produced 42 bushels more shelled corn per acre than where straw was plowed under.

This higher growth and yield on mulched plots was found to be due to the greater supply of moisture under the mulch during the period of high plant moisture requirements--from tasseling to early dough stage. Available soil moisture in the top 1½ feet of soil from July 1 to maturity ranged from 1/4 to 1-1/3 inches greater on mulched corn for the 3 years.

Va. Agr. Expt. Sta., Blacksburg, Va.

PLANT MANAGEMENT

Pastures and Haylands

Lorenz, R. J., and Rogler, G. A. A COMPARISON OF METHODS OF RENOVATING OLD STANDS OF CRESTED WHEATGRASS. *J. Range Mangt.* 15: 215-219. 1962.

Ten renovation treatments involving complete, partial, and no destruction of the old sod were compared on a 17-year old crested wheatgrass pasture for 12 years.

Killing 1/3 of the grass plants by scarification with a field cultivator resulted in a decrease in production the year of treatment and an increase in production 1 year after treatment. Yield increases from scarification were not significant for the remainder of the 12-year period.

Application of phosphorus or seeding sweet clover on scarified sod showed no advantage over scarification alone. Alfalfa seeded on scarified sod was very slow to become established, but after the fifth year following seeding the alfalfa, this treatment produced more forage than scarification alone.

Killing all the old plants by plowing and reseeding resulted in very high yields the second year after reseeding the grass; however, 2 years of production were lost in establishing the new stand and the new stand rapidly declined in productivity. This method had very little long-time advantage over scarification. Growing corn rather than fallowing the plowed sod supplied a crop for one of the two production years lost during reseeding, but the first hay crop and the total production for the first 3 harvest years were significantly decreased when the corn crop was grown.

The outstanding renovation treatment was application of N to undisturbed sod. Yields were significantly increased by each of the two 30-pound increments of N in each year, including the first year of application, except in the drought year of 1952. Yields of the 30- and 60-N treatments averaged 2.5 and 3.7 times those of the check for the 12-year period. Scarification before application of 30-N produced no more herbage during the 12-year period than 30-N applied to undisturbed sod.

Removal of the fringed sage by spraying significantly increased yields of all treatments.

The results indicate that a combination of weed control and nitrogen fertilization should be an effective means of renovating low-producing crested wheatgrass stands containing a fair to good stand of low-vigor plants in areas having enough soil moisture during the spring to promote active growth of the grass.

U.S. Northern Great Plain Field Station, CRD, ARS, USDA, Mandan, N. Dak.

Willhite, F. M., Lewis, R. D., and Rouse, H. K. IMPROVING MOUNTAIN MEADOW PRODUCTION. U.S. Dept. Agr., Agr. Res. Serv. Agr. Inform. B. 268, 22 pp. 1962.

Ranching practices on mountain meadows in the Western United States have been under research since 1950. Comparisons have been made between ranches operated by traditional procedures and those on which modern research findings were applied. The important conclusions drawn from these comparisons are reported and some additional facts and figures are given.

A survey showed that information acquired through research was being applied mostly by ranchers who lived near experimental sites or who attended field-day demonstrations. Some of these ranchers were able to increase their production as much as 600 percent.

They learned how to conserve water by applying less to the meadow and using the surplus on new lands. They learned how to grow about 5 tons of hay where one grew before, and how to produce about 6 times as much beef on the acreage they owned.

These ranchers centered their efforts on the improvement of water efficiency, area efficiency, soil efficiency, crop adaptation, forage management, and livestock management. They regarded the cost of many of the improvements as capital investment.

Photographs and tables.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Matches, A. G., Mott, G. O., and Bula, R. J. VEGETATIVE DEVELOPMENT OF ALFALFA SEEDLINGS UNDER VARYING LEVELS OF SHADING AND POTASSIUM FERTILIZATION. *Agron. J.* 54: 541-543. 1962.

The effects of three light treatments (full sunlight, 46 and 69 percent light reduction) and three levels of potassium fertilization (0, 125, and 250 pounds of K per 2 million pounds of dry soil) upon the development of three varieties of alfalfa (Du Puits, Vernal, and African) during the initial season of establishment (1958) were investigated.

The relative range of plant height differences were too small to be considered of practical importance even though plant height means and interactions were significantly different.

Varieties did not differ in top dry weight accumulation, but did so for root dry weight accumulation. The African variety tended to have the lowest root dry weight, while Vernal and Du Puits were very similar. A potassium X variety X light interaction was noted in the case of top dry weight accumulation.

Light reductions imposed when the plants were 6 weeks old had much more influence upon root dry weight accumulation than upon top dry weight accumulation. Lowest dry weight accumulation occurred under the 69 percent light reduction treatment. Root dry weight accumulation was influenced both by the interactions of dates X varieties, and dates X light.

Root dry weight accumulation tended to level off when the plants were 14 to 16 weeks old. However, dry weight accumulation of tops reached a less distinct plateau.

Potassium fertilization had no influence upon top dry weight. Root dry weight was increased with potassium fertilization.

The root/top dry weight ratio was influenced by the same factors affecting root dry weight accumulation with the exception of light.

CRD, ARS, USDA, Columbia, Mo., 65202.

Brown, B. A. SILAGE CORN EXPERIMENTS. *Conn. Agr. Expt. Sta. B.* 372, 27 pp. 1962.

Silage corn has produced the largest yields of dry matter of any forage crop tested at the Experiment Station at Storrs, Conn. In 1960, Penn 602A corn in 18" rows and with 29,000 plants per acre produced 16,700 pounds of dry matter. Vernal alfalfa yielded 10,500 pounds in two cuttings and there was an estimated additional 3,000 pounds in the not-harvested third cutting. The alfalfa and corn were liberally fertilized.

According to feeding standards, corn silage with a fair proportion of ears has more digestible nutrients than alfalfa silage.

From experiments with silage corn at the Storrs Station it was concluded that:

1. The highest yield of Penn 602A in 1960 was obtained with 29,000 plants per acre; in 1961, with 42,000 plants. Stands of over 50,000 plants per acre lodged during storms with high winds.
2. The best results occurred when each plant was alone in the center of its allotted area. Corn in rows 18" apart outyielded equal populations of the same variety with 36" between rows in 1960-61.
3. Maximum yields of dry matter were obtained by planting varieties which did not pass the medium dough stage during the local frostfree season.
4. In a 4-year comparison, a "medium" season variety produced 800 pounds more dry matter and a late maturing variety 1,400 additional pounds, when planted in early, rather than late May.
5. Corn increased in concentration and yield of dry matter until the late dough stage although it reached its maximum vegetative growth 40 to 50 days earlier.
6. Corn responded well to liberal fertilization. For stands of 20,000 plants on land tilled for two or more previous years, the pounds per acre of nitrogen (N), phosphoric acid (P_2O_5) and potash (K_2O) indicated were, respectively, 160, 80, and 120.
7. Weeds competed strongly with corn for light, water, and plant nutrients. Both broadleaved and grassy weeds were controlled with the new herbicides. Some cultivation to break crusts and thereby facilitate infiltration of water was beneficial, especially on heavy or frequently tilled soils.

J. Conn. Col. Agr. Expt. Sta., Storrs, Conn.

Rangelands

Gates, D. H. REVEGETATION OF A HIGH-ALTITUDE, BARREN SLOPE IN NORTHERN IDAHO. J. Range Mangt. 15: 314-318. 1962.

The effects of several mulch and fertilizer treatments on emergence and establishment of grasses on high-altitude, harsh-environment sites were studied in northern Idaho. Mulch treatment included two rates of sawdust, two rates of evergreen boughs, native hay, and asphalt emulsion. Fertilizer treatments included lime and various rates of nitrogen, phosphorus, and potassium. Several grasses not indigenous to the area were seeded with the various mulch and fertilizer treatments.

Except for native hay, all mulch treatments were considered failures. Native hay mulch held in place by chicken wire boughs resulted in good grass establishment. Field application of fertilizer did little to increase grass emergence and had no effect on seedling survival. Fertilizer studies in the greenhouse with soil from the experimental area indicated no increase in number of seedlings as a result of fertilizer or lime. Fertilizer and lime both increased the amount of herbage produced.

The following conclusions were drawn from these studies:

1. Mulch treatments increased seedling emergence of seeded grasses.
2. Owing to extremely harsh environment, seedling mortality was high.
3. Non-indigenous grasses did not appear to be adapted to the experimental sites.
4. Indigenous grasses established as a result of native hay mulch appeared to be adapted to the sites.
5. Grass breeding and selection of native grasses for extreme environments are definitely needed.

6. Stabilization and revegetation on sites included in this study was costly and of long duration.
7. Owing to the critical nature of the sites, high costs of revegetation, in excess of that which could be justified for herbage alone, were justified.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Coarsegold, Calif.

Renner, F. G., and Allred, B. W. CLASSIFYING RANGELAND FOR CONSERVATION PLANNING. U.S. Dept. Agr., Soil Conserv. Serv. Agr. Hbk. 235, 48 pp. 1962.

Attempts to appraise the resources of rangeland and to develop information useful in its management have been underway in the United States for about 50 years.

The procedures used in the Soil Conservation Service to collect information on the capability of rangeland are described and the ecological basis for range sites are explained. How this information can be used in conservation planning was shown.

SCS, USDA, Inform. Div., Washington, D.C., 20250.

Hyder, D. N., and Forrest, A. S. SELECTIVE CONTROL OF BIG SAGEBRUSH ASSOCIATED WITH BITTERBRUSH. J. Range Mangt. 15: 211-215. 1962.

The results of spraying mixed stands of big sagebrush and bitterbrush with 2,4-D and 2,4,5-T provide a guide for moderately successful selective control of big sagebrush on dry sites. These two herbicides were applied at 1.5 and 3.0 lb./A on six dates each in 1958 and 1959. Their effects were evaluated by mortality counts and crown reduction estimates.

An ester of 2,4-D was slightly more selective for big sagebrush than 2,4,5-T ester, and may be applied at recommended rates (1.5 to 2.0 lb./A.) for the selective control of big sagebrush under the limitations imposed by: (1) The stage of growth development of bitterbrush; (2) the duration of favorable growing conditions after spraying; and (3) the size of bitterbrush plants.

Delaying spraying progressively from the time of leaf appearance until early fruit development of bitterbrush resulted in greater 2, 4-D damage. Spraying at any time killed virtually all leaf tissue and current twig growth of bitterbrush; however, spraying at the time of leaf origin and before the appearance of distinct twig elongation or flowers left only a small amount of dead tissue on large plants. Subsequently, dormant buds initiated new growth, and in the autumn only slight evidence of spray injury remained. The amount of growth attained from dormant buds depended upon the duration of favorable growing conditions after spraying. In contrast to large bitterbrush, those less than 12 inches tall were killed consistently.

The proper timing for spraying mixed stands of big sagebrush and bitterbrush on dry sites is indicated by the appearance of: (1) New leaves on big sagebrush and bitterbrush; and (2) heads of Sandberg bluegrass. Spraying may then continue until bitterbrush is in flower.

CRD, ARS, USDA, Burns, Oreg.

Johnsen, T. N., Jr. ONE-SEED JUNIPER INVASION OF NORTHERN ARIZONA GRASSLANDS. Ecol. Monog. 32: 187-207. 1962.

Various factors affecting one-seed juniper invasion of northern Arizona grasslands were studied in the field, greenhouse, and laboratory from 1954-60. The tree was found to be well adapted to the semiarid areas in which it grows and establishment of the individual tree is the most critical phase in its life history.

Since its seeds are widely dispersed by animals native to the woodlands and adjacent areas, increased seed dispersal by livestock does not wholly explain the present invasion of grasslands by juniper woodland.

Drought favors establishment of dominance by trees already in the community rather than the initiation of juniper invasion. The larger trees with their appressed scalelike leaves and extensive root systems are well adapted to drought conditions whereas the small trees are killed or severely damaged by short-term droughts which the grasses easily evade.

Competition for moisture is very important in the establishment of one-seed juniper. During the initial growing seasons, competition may stunt or kill the seedling; however, competition may not prevent juniper invasion of grasslands during wet years favorable to tree establishment. Reduction of competition helps accelerate invasion.

Once the tree is established it begins to dominate the area around it. The extent of this domination depends on the size of the tree and on soil texture.

Small one-seed junipers are killed by grass fires. However, with reduced competition, the tree may become large enough not to be markedly affected by fires.

Much of what is called juniper invasion is occurring in former juniper savannahs and grassland inclusions within the pinyon-juniper woodlands. These areas were probably maintained as open stands or grasslands in the past by competition and frequent grass fires.

Within northern Arizona grasslands are numerous postclimax one-seed juniper stands with microclimatic and soil variations which result in habitats more mesic than the surrounding grassland. The junipers maintain themselves on these areas but are not invading the surrounding grassland.

CRD, ARS, USDA, Rocky Mountain Forest and Range Expt. Sta., Flagstaff, Ariz.

Plant Materials

Henson, P. R., and Schoth, H. A. THE TREFOILS--ADAPTATION AND CULTURE. U.S. Dept. Agr. Agr. Hbk. 223, 16 pp. 1962.

The perennial trefoils, Lotus species, are important legumes on various soil areas of the United States for permanent pasture and hay.

Three species of trefoil are presently grown in various areas of the United States: Birdsfoot trefoil (Lotus corniculatus L.), narrowleaf trefoil (L. tenuis Wald et Kit.), and big trefoil (L. uliginosus Schkuhr).

This is a complete "culture and care" publication on the trefoils grown in the United States.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Borell, A. E. RUSSIAN-OLIVE FOR WILDLIFE AND OTHER CONSERVATION USES. U.S. Dept. Agr. L. 517, 8 pp. 1962.

For wildlife food and cover in the Western and Plains States, no other tree surpasses the Russian-olive. Few other trees are so well adapted to such a wide range of soil and climate.

Russian-olive has many conservation uses. It is useful for farmstead and field wind-breaks, snow traps, gully and streambank plantings, hedgerows, and living fences. Unsightly waste areas and odd corners planted to Russian-olive add beauty to the farm or ranch and make ideal spots for attracting wildlife.

The silvery foliage and gracefull, irregular shape of Russian-olive give it a place in many kinds of landscape plantings. The bees use its blossoms to produce high quality honey. Its wood makes good fuel and fair fenceposts.

More than 50 kinds of birds and mammals eat the fruit of Russian-olive. Of these, there are 12 kinds of game birds, including pheasant, grouse, mallards, and 4 kinds of quail.

Although Russian-olive sheds its leaves in winter, its spreading, thorny branches and thicket-forming growth make excellent wildlife cover.

Mourning doves, mockingbirds, and several other kinds of birds use Russian-olive for nesting.

This is an illustrated "culture and care" publication on Russian olive.

SCS, USDA, Inform. Div., Washington, D.C., 20250.

Canode, C. L., Robocker, W. C., and Muzik, T. J. GRASS SEED PRODUCTION AS INFLUENCED BY CHEMICAL CONTROL OF DOWNY BROME. Weeds. 10: 216-219. 1962.

Five experiments were conducted over a 3-year period to evaluate production of grass seed as influenced by chemical control of downy brome. These experiments involved three perennial grass species and the application of herbicides at various rates and dates at three locations.

IPC and CIPC were the most effective herbicides used in these experiments for controlling downy brome without serious injury to perennial grasses grown for seed production. Both of these herbicides were usually effective when applied at 4 and 5 lb./A. in the fall after the emergence of the downy brome. IPC and CIPC at 3 lb./A. were not satisfactory for controlling downy brome and a 7 and 8 lb./A. caused serious injury to the perennial grasses in most of the experiments. However, the seed production of Manchur smooth brome was significantly increased when CIPC was applied at 7 lb./A. in November for the control of downy brome at Pomeroy, Washington.

Endothal at 4 lb./A. gave good downy brome control at Spokane, but was unsatisfactory for control at Hooper and Pomeroy. Injury to the perennial grass was apparently less with endothal than with IPC and CIPC.

Application of IPC and endothal in September resulted in less injury to seed production than application in October, and the degree of injury increased with applications made in November and December.

Amitrole, TCA, dalapon, diuron, monuron, and simazine were effective in controlling downy brome at certain rates but caused excessive damage to the seed crop at the lowest effective rates.

CRD, ARS, USDA, Pullman, Wash.

Woodlands

Lemon, P. E., and Schumacher, F. X. VOLUME AND DIAMETER GROWTH OF PONDEROSA PINE TREES AS INFLUENCED BY SITE INDEX, DENSITY, AGE, AND SIZE. *Forest Sci.* 8: 236-249. 1962.

Measurements of periodic volume and diameter growth were made on 557 dominant and codominant trees of ponderosa pine in Western United States by sampling the soil, site quality, age, height, diameter, overstory and basal area density of the surrounding stands. The spherical densiometer and point sampling with an angle gauge were both used to measure overstory and basal area density around each sample tree.

The data were studied and mathematically analyzed to determine the relative direct and interacting influence of items measured upon periodic volume and diameter growth of sample trees. Four equations are presented by which predictions of periodic growth can be made from measurements of sample trees growing for short test periods under known conditions of competition and soils of known site quality. Periodic growth is expressed in the four equations as γ_1 , last 5-year periodic annual cubic feet volume; γ_2 , last 10-year periodic annual cubic feet volume; γ_3 , last 5-year radial growth in inches; and γ_4 , number of rings (years) required to increase the last radial inch. Multiple correlation coefficients of these four equations respectively are: 0.949; 0.962; 0.714; and 0.774.

Overstory density of the surrounding stand, as measured by the spherical densiometer, was significantly correlated with periodic volume and diameter growth in each of the four growth equations. This variable was dropped from the equations because the rival variable, basal area, contributed more strongly to the predictions.

The influence of basal area density of the surrounding stand on volume and diameter growth of sample trees, considered separately for the dominant and lowerstory portions, were studied in each of the four equations. Only the basal area of the dominant portion of the surrounding stand contributed significantly to periodic growth of sample trees. It was found that 71 percent (± 10 percent) of the total basal area was contributed by the dominant portion irrespective of site or age.

SCS, USDA, Washington, D.C., 20250.

Vries, J. L. De., and Wilde, S. A. EFFECT OF THE DENSITY OF RED PINE STANDS ON MOISTURE SUPPLY IN SANDY SOILS. *Netherland J. Agr. Sci.* 10: 235-239. 1962.

The content of moisture was determined periodically from April till November by the neutron scattering probe in non-podzolic outwash sand supporting a 17-year-old fully-stocked red pine plantation and parts of the same plantation reduced 50 percent by thinning. The current diameter increment of average trees was recorded by means of ring band dendrometers.

The supply of water in the 4-foot root zone of the thinned plantations during the entire growing season averaged nearly 10 percent. This soil gained some moisture from rainfall during the critical mid-summer period. The soil of the fully stocked stand in the beginning of the growing season exhibited a high content of moisture because of a delayed thaw. Early in July a decrease of water content below the field capacity of 7 percent coincided with a retarded diameter growth of trees, probably because of the restricted capillary transfer and depletion of moisture in the immediate vicinity of absorbing roots. The study indicates

that 50% thinning reduced the growing stock beyond the permissible limit; it failed to fully utilize the available supply of water and thus provided conditions favorable for invasion of weed vegetation; it led to a loss of current growth, expressed by the difference between 2,300 trees with diameter increment of 0.17 inches and 1,150 trees with diameter increment of 0.31 inches.

347 Sportlaan, The Hague, The Netherlands.

Langenheim, J. H. VEGETATION AND ENVIRONMENTAL PATTERNS IN THE CRESTED BUTTE AREA, GUNNISON COUNTY, COLORADO. Ecol. Monog. 32: 249-285. 1962.

Vegetation patterns, ranging in altitude from 8,500 to 13,500 ft., were mapped and studied in connection with geologic mapping of approximately 100 sq. mi. in the Crested Butte Area in west-central Colorado. Geologic diversity has contributed to production of both a diverse flora and vegetation patterns.

The sagebrush community type dominated by Artemisia tridentata occurs from 8,500 to 12,500 ft., but forms a prominent belt only from 8,500 to 9,500 ft.

The aspen community type occurs from 8,500 to 11,200 ft., but forms an altitudinal belt from approximately 9,500 to 10,500 ft. either as a continuous forest below the spruce-fir belt or as groves invading fescue grassland. Homogeneity of the aspen type is primarily dependent upon the dominant Populus tremuloides. The spruce-fir community type, dominated by Picea engelmannii and Abies lasiocarpa, is the most extensive in the Crested Butte area. Spruce and fir occur from 8,500 ft. along stream-sides to 12,500 ft. as patches of Krummholz. The community type, however, forms a definite belt only from approximately 10,500 to 11,500 ft.

Lodgepole pine, aspen, and burn grassland community types replace burned spruce-fir forest, with the latter being the most extensive. Lodgepole pine and aspen dominate burned areas in the 9,500 to 10,500 ft. range. Burn grassland dominates fire scars from 10,500 to 11,500 ft., occurring on all exposures but only on heavy soils.

The upland herb community type is characteristic of non-forested areas from 10,500 to 12,500 ft., but forms a zone only from approximately 11,500 to 12,500 ft. It is characterized by a predominance of forbs as well as sedges and grasses. Distribution of the high-altitude willow community type closely parallels that of the upland herb type, but it occupies less area.

Alpine community types reach their optimum development from 12,500 to 13,500 ft., although they interfinger with the upland herb type as low as 12,000 ft.

The fescue grassland is considered transzonal because it occurs within the matrix of all zonal community types from 8,500 to 12,500 ft. Successional status appears to vary; in some areas the community type seems to be an edaphic climax but in others it is being invaded by aspen. Festuca thurberi is the dominant species.

The vegetation patterns of the Crested Butte area appear more closely allied with those of southwestern Colorado and mountainous areas in the Great Basin than those of other areas in the Colorado Rockies, particularly the eastern slope.

U. Ill., Urbana, Ill.

Quarterman, E., and Keever, C. SOUTHERN MIXED HARDWOOD FOREST: CLIMAX IN THE SOUTHEASTERN COASTAL PLAIN, U.S.A. Ecol. Monog. 32: 167-185. 1962.

Hardwood stands on mesic uplands in the pine belt of the Coastal Plain of the Southeastern United States were studied. The pine-hardwood and immediate post-pine stages in forest succession were described to fit them into a regional context, clarifying, if possible, the existing theories on the climax of the region.

Ninety-three hardwood or pine-hardwood dominated stands on mesic sites were located in the Coastal Plain between northern South Carolina and the Trinity River in eastern Texas. The woody vegetation was studied by the nested quadrat method in 30 of the largest and least disturbed of these stands. Lists of woody species were made in all other stands. Attempts were made to correlate differences and/or similarities of these communities to possible variations in moisture conditions, soil characteristics, geographic location, and past treatment of the stands. Past treatment, including kind and degree of disturbance and length of intervals between disturbances, appeared to have a greater effect upon composition and structure of the forest than did the other factors.

Fourteen species are structurally important in pine and pine-hardwood stands of the entire region. In descending order of importance, the potential overstory hardwood species on this list (group I) are: Fagus grandifolia, Quercus laurifolia, Magnolia grandiflora, Quercus alba, Liquidambar styraciflua, Carya tomentosa, Quercus nigra, Quercus falcata, Carya glabra, Nyssa sylvatica var. dilatata, and Ilex opaca. Pinus taeda, although important in this group at the present time, is rapidly being replaced as a major dominant. Cornus florida and Vaccinium arboreum are the only potential understory species meeting the criteria for Group I. Potential overstory species in Group II are: Acer barbatum, Pinus glabra, Quercus michauxii, Tilia spp., Carya pallida, Fraxinus Americana, Ostrya virginiana, Halesia spp., Cercis canadensis, and Oxydendrum arboreum. Species of Group I contributed 86 percent of the total overstory importance, and Group II contributed 8 percent, leaving only 6 percent in Group III or incidentals.

This is a complex forest in which a number of species share dominance. In spite of its complexity, however, the Southern Mixed Hardwood Forest is a recognizable vegetational entity. In the oldest and least disturbed stands on mid-mesic sites, 5 to 9 hardwood species are co-dominant, and all or most of the dominants are reproducing effectively. The lower layers of pine-dominated stands are composed of the same combinations of hardwood species that were important in the hardwood-dominated stands. Pines are reproducing poorly in closed canopy stands dominated by either pines or hardwoods.

The tendency for stands on mesic sites to resemble the Southern Mixed Hardwood forest type increases with age and with freedom from disturbance.

Vanderbilt U., Nashville 5, Tenn.

Carter, M. C., and Jones, L. THE EFFECT OF HYDROGEN PEROXIDE ON THE GERMINATION OF LOBLOLLY AND SLASH PINE SEED. Southeastern Forest Expt. Sta., Sta. Paper 141, 12 pp. 1962.

The effect of hydrogen peroxide upon the germination of slash and loblolly pine seed was studied. A 48- to 96- hour soak in 1 percent hydrogen peroxide increased the speed of germination of loblolly pine seed to the point where it equalled that obtained by stratification. However, this treatment had no effect upon the total germination. Soaking the slash pine seed in 1 percent hydrogen peroxide for 24 to 48 hours increased both the rate and extent of germination beyond that of stratified seed. Changing the peroxide solutions daily and varying the solution volume did not alter the stimulating effect of the H_2O_2 , but storage of the seed at 38° F. for 3 days following treatment produced a significant reduction in the germination rate.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C.

Baron, F. J. EFFECTS OF DIFFERENT GRASSES ON PONDEROSA PINE SEEDLING ESTABLISHMENT. Pacific Southwest Forest and Range Expt. Sta. Res. Note 199, 8 pp. 1962.

In September 1957, several thousand acres of old brush, growing on sites formerly covered by pine stands, were severely burned in Siskiyou County, California. The intense fire consumed all the aerial parts of the vegetation and most organic matter in the topsoil. Since both timber production and grazing are important in the area, rehabilitation was planned to restore both, and to reduce the threat of erosion.

Ponderosa pine and eight grass species were planted together. Less than half the pines were dead after 3 years, whether in grass areas or not. When pine was planted in year-old grass, 80 percent died. Of pines planted without grass, only 30 percent died.

In the first-year plantings, pine establishment was not seriously impeded by four species of grass (bluegrass, wheatgrass, redtop, and fescue) but was impeded by four other species (oatgrass, rye, timothy, and orchardgrass). In second- and third-year tree plantings, the harmful effects of grasses (presumably competition for soil moisture) became more apparent for all grass species. Tree survival was somewhat better where native brush regrowth was sprayed with 2,4-D, but not as good as on plots planted immediately after the fire.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Buckman, R. E. THREE GROWING-STOCK DENSITY EXPERIMENTS IN MINNESOTA RED PINE: A PROGRESS REPORT. Lake States Forest Expt. Sta., Sta. Paper 99, 10 pp. 1962.

Three growing-stock density studies of red pine grown in Minnesota are described. Although the studies differed in stand age (40, 50, and 80 years) and in details of design, they were all on a medium site and had the common densities of 60, 80, 100, 120, and 140 square feet of basal area per acre at the beginning of 5-year cutting cycles.

Basal area growth was described by three shallow curves. Between the three experiments, basal area growth differed in magnitude, but the shapes of the individual curves were practically identical.

Periodic annual height growth was unaffected by stand density. Total cubic volume growth increased with stand density, and this increase was most pronounced in the two younger stands. Since basal area growth was little affected by stand density and height growth was unchanged, higher cubic volume growth occurred in high density stands because there were more stems (or more basal area) upon which to add height growth.

Cordwood growth for the two younger stands followed the pattern of cubic volume growth, reaching 1.3 to 1.4 cords per acre per year in the 120- and 140-square-foot densities. Board-foot growth in the 80-year red pine tended to follow the pattern set by cubic volume growth although ingrowth distorted the pattern slightly.

For all three experiments, diameter growth of both the 100 largest trees per acre and the dominant and codominant trees was roughly twice as much at 60 square feet as it was at 140 square feet. Ten-year diameter growth of dominant and codominant trees did not differ significantly between the three experiments. Ten-year diameter growth of the 100 largest trees per acre averaged about 0.25 inch greater in the 40-year than in the 80-year red pine study, with the 50-year red pine falling between the two.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Buckman, R. E., and Lundgren, A. L. THREE PINE RELEASE EXPERIMENTS IN NORTHERN MINNESOTA. Lake States Forest Expt. Sta., Sta. Paper 97, 9 pp. 1962.

Three release experiments were begun in northern Minnesota by the Civilian Conservation Corps program in the 1930's. Two of the experiments tested the response of pines to full, moderate, and no release from competing hardwoods. The third experiment tested only moderate and no release of pine hardwoods.

Eighteen to 25 years later the three experiments were given final measurements. the results of the three experiments were:

1. The early advantage in species composition given the pines by hardwood removal was largely maintained. The coniferous component of the no-release plots increased, but considerable portions of the plot volumes were still in hardwood.
2. The average size of pine trees was appreciably larger on the released than on the no-release plots at the end of the measurement periods.
3. Although cordwood volumes were reduced considerably by release, the faster growing pines not only recovered the lost volume, but at the end of the measurement period the release plots actually had more volume than did no-release plots.
4. Conifer sawtimber volumes increased with the intensity of release.
5. The cost of release and market expectations greatly influence decisions about release. The three release study areas indicated that under some conditions release is an excellent investment opportunity in forestry.
6. Release, although effective in these three studies, would probably have been cheaper and more effective if it had been done at earlier stand ages. Silvicides, applied by hand in frills or girdles, or sprayed from the air, would be used in many of these situations today.
7. The more complete the release, the more favorable the response of the valuable conifers. Sometimes full release can be achieved without too much additional cost.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Barrett, J. W., Farnsworth, C. E., and Rutherford, W., Jr. LOGGING EFFECTS ON REGENERATION AND CERTAIN ASPECTS OF MICROCLIMATE IN NORTHERN HARDWOODS. J. Forestry 60: 630-639. 1962.

The effects of various cutting practices on certain environmental features of the stand, the behavior of residual trees following partial cutting, and the development of regeneration have been studied in an old growth stand of northern hardwoods since 1956. This stand had been relatively undisturbed by man or fire within the past several hundred years. The treatments were: Partial cutting that reduced the residual stand to 70, 50, and 30 square feet of basal area per acre; clearcutting; poisoning of subordinate trees; scarification; and erection of deer exclosures.

Reduction in stand density by logging resulted in an increase in air temperature 1 inch above the forest floor. The difference, during one summer period, between mean and maximum temperatures of uncut plots with a basal area of 129 square feet per acre and partially cut plots with 51 square feet was 14° F. On one occasion, a logged stand showed temperatures 23.2° F. greater than in an adjacent uncut stand. During the summer of 1959, maximum air temperatures of 107° F. were recorded on clear-cut plots while those for the uncut plots were 95° F.

Forest cover also affects surface soil temperature. When stand density was reduced below 60 square feet of basal area per acre there was an appreciable increase in the number of days during a given summer period when the surface of the soil exceeded 113° F. Surface

soil temperatures in excess of 138° F. occurred on plots with less than 60 square feet of basal area per acre but did not take place on plots with greater density.

Soil moisture at a depth of 4 and 11 inches was consistently higher during the summer in clearcut plots than it was on partially cut or uncut plots. From June through September, soil moisture typically ranged between field capacity and wilting point.

Yellow birch regeneration has responded vigorously to openings caused by logging and to favorable seedbeds created by scarification. Partial shade has proven beneficial to initial seedling establishment. Where the subordinate understory was poisoned, maximum numbers of seedlings occurred under stands containing 60 to 80 square feet of basal area per acre. Where the understory was not treated, maximum numbers were found in stands with about 40 square feet of basal area per acre. Lighter, but still adequate, stocking took place with heavier cutting than noted.

Sugar maple has not shown a favorable response to the cutting. There were fewer seedlings less than 4 years old tallied in 1960 than in 1958 and maple stems 3 feet tall to 1/2 inch in diameter have not moved up into larger size classes.

American beech seems to be taking advantage of the openings created with heavier cutting. The uncut plot showed a reduction of 14 stems per acre, in the 3 feet tall to 4 inches d.b.h. size classes, in the 2 years since logging; beech stems of these sizes in the plots containing about 30 square feet of basal area per acre increased by 38; and in the clearcut plots the increase per acre in stems 3 feet tall to 4 inches d.b.h. was 128. There were no indications that beech had suffered from exposure.

Rubus spp. has responded vigorously to heavier cuttings. Little increase in number of rubus plants took place until stands were reduced below 70 square feet of basal area per acre.

Two years after logging, the quantitative measure of stems in the plots fenced against deer differed little from that of the unfenced plots. Some browsing has taken place on the unfenced plots but the results to date have not been sufficiently great to be significant.

State U. Col. Forestry, Syracuse, N.Y.

Franklin, J. F. MOUNTAIN HEMLOCK--A BIBLIOGRAPHY WITH ABSTRACTS. Pacific Northwest Forest and Range Expt. Sta. Res. Paper 51, 50 pp. 1962.

This bibliography lists references pertaining to mountain hemlock (Tsuga mertensiana (Bong.) Carr.) found in North American and European literature. The author has attempted to include all references that might provide useful information on this species; abstracts are provided for those considered most significant. Articles are listed alphabetically by author.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

Squillace, A. E., and Silen, R. R. RACIAL VARIATION IN PONDEROSA PINE. Forest Sci. Monograph 2, 27 pp. 1962.

Data from two ponderosa pine studies conducted in north Idaho (45 years old) and Oregon and Washington (30 years old) were analyzed in detail. The results verify apparent differences in growth rate found earlier and correlate the differences with various geographic and climatic factors of the seed source localities. The two studies sampled nearly the entire range of the species. In the northern Idaho study, trees of 20 sources were planted at one locality while in the Oregon-Washington study trees of 10 sources were planted in 5 localities.

Results proved that inherent differences in rate of height growth existed among trees in various regions of the range of ponderosa pine. Approximately 36 percent of the variation in total height among trees within a plantation was found to be due to seed source. Growth rates seemed to increase as clines going from east to west, and from south to north in the eastern portion of the range of the species. Evidence of an altitudinal cline, with increasing growth rate going from high to low altitude was also shown. No strong latitudinal effect was apparent in the west.

Among several climatic variables of the seed source localities, height growth of progenies was most strongly correlated with the moisture distribution (expressed by September-through-June precipitation as a percent of annual) ($r = 0.54$ to 0.81) and mean April-May temperatures ($r = 0.37$ to 0.82). Growth was also correlated with absolute September-through-June precipitation ($r = 0.36$ to 0.73), but to a lesser extent than the relative measure. The fastest growing trees were mostly from localities having high proportions or absolute amounts of September-through-June precipitation and high April-May temperatures. The strong longitudinal cline was largely associated with moisture distribution, while the altitudinal and latitudinal clines were largely associated with April-May temperatures.

The characteristic of inherent slow growth in the eastern and southeastern parts of the species' range probably resulted from an adaptation to relatively cool spring-summer temperatures and high summer rainfall with relatively little precipitation in the fall, winter, and spring. Under these conditions, seedlings germinate late, and trees are also late in starting spring growth. In the northeast habitats, low fall and winter precipitation at low altitudes and cool spring temperatures at high altitudes restrict growth. The possibility is not ruled out that the slow growth may be linked to increased resistance to prolonged drought. In the optimum conditions of the extreme west and northwest, natural selection possibly favors growth rate to a greater degree than in the more critical climates of the east.

Some rapidly growing trees may fail completely in extreme environments. Limited data showed that the spread between July and January mean temperatures may be a fair indicator of frost resistance--trees from localities having greater temperature extremes were found to be more resistant than those from habitats having less variation in temperature.

Inherent differences among the seed sources were also shown for diameter growth, volume growth, stem taper, survival, browsing preference by wild animals, onset of cambial growth, and needle length. A moderately strong correlation ($r = 0.64$) was shown between average needle length of trees on the plantations and average needle length of trees growing in their corresponding native habitats. Similarly, rather strong relations ($r = 0.54$ to 0.89) between needle length and height growth rate were shown.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Hepting, G. H., and Fowler, M. E. TREE DISEASES OF EASTERN FORESTS AND FARM WOODLANDS. U.S. Dept. Agr., Forest Serv. Agr. Inform. B. 254, 48 pp. 1962.

Tree diseases take a heavy annual toll of timber from forests and farm woodlands. Much of this loss is preventable. In the United States, diseases ruin each year 40 percent as much timber as is cut. Many diseases kill trees or reduce their growth rate, but the major loss to the forest results from those that cause standing timber to decay or otherwise become defective. Trees decaying faster than they are putting on new wood, or so defective they will never produce a usable product, are liabilities rather than assets in the farm woods or forest. Much disease damage, such as that caused by rots, does not become evident until timber is cut, and then it is too often accepted as inevitable. Bark diseases that appear as open wounds or cankers on the trunk are often regarded as merely mechanical injuries. Blister rust may be easily overlooked as the cause of death of young white pines.

In this bulletin, the term "diseases" includes all tree abnormalities other than those caused by insects. Trees are susceptible to disease throughout their life--from seed to maturity or harvest. Seeds decay and seedlings damp-off; young trees are attacked by leaf diseases, cankers, and decays; and older trees are subject to these and still other maladies. Most of these maladies are caused by fungi, but some are caused by bacteria, mistletoes, and viruses. These may be due to water or nutrient excesses or deficiencies, poisonous substances in the soil or air, excessive heat or cold, or other causes.

Farm woods and other heavily used small holdings are particularly susceptible to diseases. They afford particularly favorable opportunities for disease control. Farm woods are healthier if protected from fire and grazing.

Frequent light cuts, made to fill the farmer's own needs for fuel, posts, and other small products, can materially improve the growing stock by eliminating defective trees and trees of species that are likely to become defective early in life, such as scarlet oak and quaking aspen. The best trees can be left to produce saw logs, crossties, poles, veneer bolts, or other marketable products. Farm woods are like money in the bank. The care given them determines whether the rate of interest they return will be high for growing quality timber, or low because of too many defective trees.

FS, USDA, Inform. Div., Washington, D.C., 20250.

Powers, H. R., Jr., and Verrall, A. F. A CLOSER LOOK AT FOMES ANNOSUS. Forest Farmer 21(13): 8-9, 16-17. 1962.

FOMES ANNOSUS root rot, though not new in the South, is causing increased concern. The intensive monoculture of planted pines, with close, uniform spacing, root malformation and damage, and early and sometimes frequent thinnings, often favors infection and spread of the disease.

Annosus root rot is easily overlooked in its early stages, and damage is sometimes attributed to other causes, primarily bark beetles. Even when conks of F. annosus are present, they are inconspicuous and usually under the needle litter at the base of a tree. Infected trees are easily windthrown, and the typical white, stringy, rotted roots are exposed to view. Standing trees with extensive root decay may retain green and healthy crowns for some time, making detection difficult.

Annosus root rot has seldom been a problem in thinned natural slash and loblolly stands, or in unthinned stands. Losses were greatest in thinned planted stands, but there should be no recommendation against thinning unless the history of a given area indicates a high root rot hazard, or stand values are unusually high. In such stands, stump treatment might be advisable following thinning.

Root rot data were taken on 84,000 trees on 476 randomly distributed plots in thinned stands of loblolly and slash pine from Virginia to Texas. There was much variation in damage among specific areas within this region, from areas with almost no damage to others with consistently high losses. The major findings of the survey are:

1. The average damage was fairly low for the plantations surveyed--2.8 percent and 2.2 percent of the trees dead or dying of annosus root rot in loblolly and slash pine plots, respectively. In some thinned plantations 30 percent or more of the residual trees were dead or dying of annosus root rot.
2. Losses in natural slash stands were very low, with only 0.07 percent of the trees dead or dying.
3. Stands on former cropland had more damage than those on land continually forested.
4. In general, damage increased as years since thinning increased. The number of dead or dying trees also increased with more frequent thinnings. Plots thinned three or more times had far more damage than those thinned once or twice.

5. Stands with coarser textured A horizons--the lighter soils--had more damage than those on heavier soils.
6. Losses tended to increase with increasing depth of the A horizon.
7. Plots on slopes suffered more damage than those on flat sites.
8. There was more killing from annosus root rot in stands with deep forest litter than in those with little or no litter.

Southeastern Forest Expt. Sta., FS, USDA, Ashville, N.C.

Furniss, M. M. EFFECTIVENESS OF DDT FOR PREVENTING INFESTATION OF GREEN LOGS BY THE DOUGLAS-FIR BEETLE. Intermountain Forest and Range Expt. Sta. Res. Note 96, 10 pp. 1962.

Infestations of the Douglas-fir beetle may result from a buildup of beetles in down trees. To determine effectiveness of DDT in preventing infestations, a 2-percent emulsion was sprayed on green logs at rates of 3 to 4 gallons per 100 square feet of bark surface prior to beetle attack.

In the first test, sprayed logs were not attacked heavily for a period of 3 weeks. Thereafter, attacks increased and broods contained in them did not differ significantly from those in unsprayed check logs. However, the number and length of bark beetle egg galleries and number of woodborer larval mines were significantly smaller in sprayed logs.

A second test was conducted to determine if the petroleum solvent in the spray concentrate by itself would repel attack and to determine effectiveness of two treatments with DDT spray. Logs sprayed either once or twice with DDT had markedly fewer egg galleries and brood, but treatment with the petroleum solvent alone did not reduce attack or establishment of brood.

Results indicated that infestation of green logs and possibly live trees were largely prevented by 2-percent DDT emulsion spray. Careful timing and uniform application were important.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Krefting, L. W., Stoeckeler, J. H., Bradle, B. J., and Fitzwater, W. D. PORCUPINE-TIMBER RELATIONSHIPS IN THE LAKE STATES. J. Forestry 60: 325-330. 1962.

The porcupine does much damage to timber. Approximately 534,000 acres of national forest land were subjected to heavy or medium porcupine damage in the Lake States region in 1960. The tree species usually damaged were: sugar maple, basswood, yellow birch, black cherry, hemlock, tamarack, jack pine, white pine, and red pine. The barking of conifers and hardwoods, and pruning the branches of hemlock in winter resulted in structural defects that produced breakage, prolific limb formation, a reduction in quality and growth rate, and sometimes mortality. Population estimates based on kill records show the density may be as high as one porcupine per acre on concentration areas, while average densities of one per 5 to 7 acres are not uncommon. In the northern hardwoods, food preferences of porcupines by tree species, based on equal number of trees of each species, were as follows: hemlock, 29 percent; basswood, 25 percent; sugar maple, 20 percent; and yellow birch, 14 percent. The tree species of highest economic value, sugar maple, yellow birch, and basswood, also suffered the greatest damage of any of the broad-leaved species. On 24 study plots, the loss per acre averaged 9.3 board feet (20.3 cents per acre per year), and the range was from none to 38.2 board feet. Porcupines showed a preference for trees of high vigor in the 9- to 15-inch diameter class.

Control by shooting appeared to be fairly practicable on selected high damage areas where it can be accomplished with other winter work.

Bur. Sport Fisheries and Wildlife, U.S. Dept. Interior.

Management of Coffee Plantations

Boyce, D. S. COFFEE PROCESSING RATIONALIZED FOR THE MEDIUM FARM. World Crops. 14: 268-274. 1962.

A brief description of coffee processing practices current in Puerto Rico where the 'wet method' is used was presented.

The artificial drying of parchment coffee was undertaken on a very empirical basis. The principal drier employed was of the rotating drum type, generally utilizing a direct heater (no heat exchanger), burning fuel oil and using air at temperatures of 150⁰-190⁰F for drying. A number of recirculation column-type driers were employed using the same type of heater.

A general description of the improved method of processing coffee cherries to dried parchment was presented. The system was designed to overcome the disadvantages associated with the current methods of processing on medium sized farms.

U. Puerto Rico, Mayaguez, Puerto Rico.

Fruit and Nut Crops

Sites, J. W., Hammond, L. C., Leighty, R. G., and Johnson, W. O. INFORMATION TO CONSIDER IN THE USE OF SOILS OF FLATWOODS AND MARSHES FOR CITRUS. Fla. Agr. Expt. Sta. C. S-135, 35 pp. 1962.

The rapid expansion of the Florida citrus industry during the last 10 years has resulted in an almost complete utilization of all well-drained land now known to be suitable for citrus. An estimated 617,000 acres of land were in bearing groves in 1960. Most of this acreage is on well-drained sandy soils in reasonably warm areas of the State. Consumer demand for citrus products has kept pace with the increased production so that the pressure for expansion has not abated. There is considerable interest in greater utilization for citrus of the vast acreages of flatwood soils now used for forest, pasture, field crops, and vegetables.

The available information to be considered in the use of soils of flatwoods and marshes of peninsular Florida for citrus was summarized. A general presentation of background information on the soils of the flatwoods and the winter temperature pattern in peninsular Florida was followed by answers to specific questions submitted to the Florida Agricultural Experiment Station by the Soil Conservation Service.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Johnson, H., Jr., Holland, A. H., Paulus, A. O., and Wilhelm, S. SOIL FUMIGATION FOUND ESSENTIAL FOR MAXIMUM STRAWBERRY YIELDS IN SOUTHERN CALIFORNIA. Calif. Agr. 16(10): 4-6. 1962.

Tests in two southern California counties resulted in similar data that offered further proof of the value of soil fumigation for strawberry production. Yield increases as high as

85 percent were reported following soil treatment. Control of plant pathogens was excellent with full-coverage injections of a mixture of 2 parts of methyl bromide and 1 part chloropicrin applied at 225 pounds per acre.

808 N. Spring St., Los Angeles, Calif.

Verner, L., Kochan, W. J., Loney, C. E., Moore, D. C., and Kamal, A. L. INTERNAL BROWNING OF FRESH ITALIAN PRUNES. Idaho Agr. Expt. Sta. Res. Rpt. 56, 38 pp. 1962.

Internal browning is a serious disorder encountered in the marketing of fresh Italian prunes. A market study in 1956 showed a high incidence of browning (up to 31%) in many lots of prunes on the day of purchase in retail stores, and an average incidence of about 50% after they had been held for 3 or 4 days at room temperature.

Internal browning is considered to be a physiological disorder associated with ripening. It may be observed before the fruit is picked but ordinarily it does not appear in a significant amount until several days to 2 weeks after harvest. The fruit of individual trees in the same orchard may differ widely in the amount of browning that develops under identical handling and storage procedures.

There was a high correlation between the firmness of the fruit and resistance to browning. The firmest prunes of any picking were very seldom affected.

Increased internal browning was caused by, or associated with, the following: Sprays of 2,4,5-TP applied in mid-May; branch girdling in early June; storage of fruit in polyethylene bags; prune leaf-curl; low tree vigor; abnormally soft fruit; delayed harvest; and gamma radiation above 80,000 reps.

Low levels of internal browning were associated with firm fruit and certain varieties.

The following had no consistent, significant effect on browning: Soil cropping history; high summer temperature; mineral nutrition other than boron and calcium; sprays of maleic hydrazide; size of crop; picking with or without stems attached; delayed cold storage; and 2, 4, 5-TP sprays applied in mid-June or later.

The following were of undetermined or uncertain effect on browning: Rootstocks; pathogens; storage temperatures; reduced irrigation; and boron and calcium nutrition.

U. Idaho, Col. Agr., Moscow, Idaho.

Zentmyer, G. A., Paulus, A. O., and Burns, R. M. AVOCADO ROOT ROT. Calif. Agr. Expt. Sta. C. 511, 18 pp. 1962.

Phytophthora root rot of avocado is a disease caused by a soil fungus, Phytophthora cinnamomi, known commonly as the avocado root rot fungus or as the cinnamon fungus. This soil organism is known to attack more than 115 species of plants. Avocado root rot is the most serious disease affecting avocado trees in many parts of the world. It has affected an estimated 4,500 acres of avocado trees in California.

An avocado planting will develop root rot if the soil contains the fungus Phytophthora cinnamomi, and if there are periods of excess soil moisture. The fungus commonly becomes active as a result of poor internal soil drainage, but may also become troublesome on the better-drained soils because of breaks in water lines, overirrigation, or excessive rainfall. Drainage may be poor because of an impervious layer under the surface soil or because the entire soil profile contains considerable clay, or because strata of different textures interfere with internal soil drainage.

Root rot can be prevented by: (1) Demanding clean nursery stock (clean seed, clean soil, clean culture); (2) planting in soil not infested with the root rot fungus; (3) planting in soils with good internal drainage; and (4) preventing movement of water, soil, and plants from infested to noninfested areas.

Root rot can be controlled by:

1. Small areas--(up to 4 trees): (1) Sampling the soil to determine fungus distribution; (2) isolating the area; (3) stopping irrigation; and (4) fumigating the soil.
2. Large areas (more than 4 trees): (1) Sampling the soil--establishing barriers; (2) irrigating carefully; and (3) replanting with a resistant crop.

Agr. Pub., Room 207 U. Hall, 2200 U. Ave., Berkeley 4, Calif.

Ford, K. E. PEACH PRODUCTION PRACTICES AND COSTS IN SOUTH GEORGIA, 1960.

Ga. Agr. Expt. Sta. Mimeo, Ser. N. S. 153, 23 pp. 1962.

Based on 1960 prices, direct costs averaged \$98.31 per acre to establish an orchard in south Georgia. This includes: \$54.78 per acre to prepare land and set trees; \$17.78 per acre to fertilize and cultivate the first year; and \$25.75 per acre during the second year of operation.

Production practices did not vary by age or by season of maturity. Inputs and costs varied for most of the different practices and necessitated presenting the data for each year of the productive period or life of the peach trees by season of maturity.

Inputs and costs of the pre-harvest practices of pruning, removing limbs, and thinning varied with age. Inputs and costs for thinning and spraying were affected by season of maturity.

Direct pre-harvest costs ranged from \$63 to \$79 per acre for early-maturing varieties and from \$54 to \$79 per acre for late-maturing varieties. Annual pre-harvest cost averages for the 7 years of production were \$68.64 per acre for early-maturing varieties and \$69.11 per acre for late-maturing varieties.

Direct harvest costs ranged from \$20 to \$56 per acre for early-maturing varieties and from \$15 to \$55 per acre for late-maturing varieties. Annual cost averages for the 7 years of production were \$43.01 per acre for early-maturing varieties and \$45.85 per acre for late-maturing varieties.

Total direct costs ranged from \$84 to \$135 per acre for early-maturing varieties and from \$69 to \$133 per acre for late-maturing varieties. Annual cost averages for the seven years of production were \$111.65 per acre for early-maturing varieties and \$144.96 per acre for late-maturing varieties.

Other costs and fixed costs added to the direct costs raised total costs to a range from \$141 to \$200 per acre for early-maturing varieties and the annual average for the 7 years of production to \$171.75 per acre. The range in total costs was \$124 to \$196 per acre for late-maturing varieties and the average for the 7 years of production was \$175.72 per acre.

Average yields for the 7 years of production were 130 bushels per acre for early-maturing varieties and 202 bushels per acre for late-maturing varieties. With slight variation in total costs per acre, higher yields per acre for later-maturing varieties resulted in lower production costs per bushel. Production costs for the 7 bearing years averaged \$1.32 per bushel for early-maturing varieties and only \$0.87 per bushel for late-maturing varieties.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Experiment, Ga.

Ford, K. E. PEACH PRODUCTION PRACTICES AND COSTS IN NORTH GEORGIA, 1960.

Ga. Agr. Expt. Sta. Mimeo, Ser. N.S. 156, 22 pp. 1962.

Based on 1960 prices, direct costs averaged \$121.43 per acre to establish an orchard in north Georgia. This included: \$42.17 to prepare land and set trees; \$19.38 to fertilize, and cultivate the second year; and \$35.48 for the three operations during the third year.

Production practices, such as pruning, and spraying, did not vary by age or by season of maturity; however, inputs and costs varied for most of the different practices. This necessitated presenting the data for each year of the productive period or life of the peach trees by season of maturity.

Inputs and costs of the pre-harvest practices of pruning, removing limbs, and thinning varied with age. Inputs and costs for thinning and spraying were affected by season of maturity.

Direct pre-harvest costs ranged from \$71 to \$81 per acre for early-maturing varieties and from \$75 to \$140 per acre for late-maturing varieties. Annual pre-harvest cost averages for the 6 years of production were \$76.12 for early-maturing varieties and \$85.86 for late-maturing varieties.

Direct harvest costs ranged from \$22 to \$39 per acre for early-maturing varieties and from \$30 to \$85 per acre for late-maturing varieties. Annual cost averages for the six years of production were \$34.14 per acre for early-maturing varieties and \$64.09 per acre for late-maturing varieties.

Total direct costs ranged from \$99 to \$115 per acre for early-maturing varieties and from \$115 to \$173 per acre for late-maturing varieties. Annual cost averages for the 6 years of production were \$110.26 per acre for early-maturing varieties and \$149.95 per acre for late-maturing varieties.

Other and fixed costs added to the direct costs raised the total to a range from \$169 to \$185 per acre for early-maturing varieties and the annual average for the 6 years of production to \$177.94 per acre. The range in total costs was \$188 to \$252 per acre for late-maturing varieties and the average for the 6 years of production was \$225.57 per acre.

Average yields for the 6 years of production were 127 bushels per acre for early-maturing varieties and 259 bushels per acre for late-maturing varieties. Even with higher total cost per acre, higher yields per acre for late-maturing varieties resulted in lower production costs per bushel. Production costs for the 6 bearing years averaged \$1.40 per bushel for early-maturing varieties and only \$0.87 per bushel for late-maturing varieties.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Experiment, Ga.

Field Crops

Palmer, J., and Wilton, G. TRANSPLANTING SUGAR BEET SEEDLINGS GROWN IN SOIL BLOCKS. J. Agr. Engin. Res. 7: 141-149. 1962.

Sugar beet sown in small molded blocks of a growth medium, and later transplanted, can yield as well as traditionally cultivated, well-managed beets.

Yields were increased by early sowing, transplanting when the seedlings were at the 2-4 leaf stage (including cotyledons), and by the addition of fertilizer to the block material.

National Inst. Agr. Engin., Scottish Station, Bush and Dryden Estates, Milton Bridge, Penicuik, Midlothian, Great Britain.

Miller, J. H., Foy, C. L., Kempen, H. M., Carter, L. M., and Hoover, M. WEED CONTROL IN COTTON. Calif. Agr. Expt. Sta. B. 791, 30 pp. 1962.

Cotton has a serious production problem--that of weed control. Weeds reduce the value of the cotton crop from 4 to 6 percent each year, and growers in the San Joaquin Valley report that they spend about \$20 an acre yearly in attempting to control them.

Weed damage often is the result of several factors. Early weeds may compete with cotton for moisture, sunlight, and nutrients, thus lowering production and increasing hand-labor costs. Heavy infestations of weeds late in the season may interfere with cotton defoliation, reduce the efficiency of both mechanical and hand pickers, and lower the grade of lint by introducing additional stains and trash.

Weed control is the principal barrier to complete mechanization of California's cotton crop.

While California cotton yields have been high, profits from them have not kept pace with increased production costs. Higher machinery costs and higher wages for hand labor have helped cause a tightening of profit margins. Further, the supply of farm workers can no longer be depended upon to handle California's cotton crop adequately, despite increased wages.

If California is to maintain its present high standing in cotton production, sound, economical weed control practices must be followed. Such practices include the best combination of cultural, biological, and chemical methods. All of these methods are described.

Tables and illustrations.

Calif. Agr. Expt. Sta., Berkeley, Calif.

Starbird, I. R., and Vermeer, J. CROP PRODUCTION PRACTICES AND COSTS BY SIZE OF FARM, DELTA AREA, MISSISSIPPI, 1957-58. U.S. Dept. Agr., Econ. Res. Serv. Agr. Econ. Rpt. 21, 71 pp. 1962.

Crop production practices, direct costs, and estimated net returns to unpaid labor, land, and management for five crops--cotton, soybeans, corn, oats, and wheat--by size of farm in the Delta area of Mississippi were studied. The basic data were obtained by taking a survey of 163 farm operating units for the crop year 1957 and 160 operating units for the crop year 1958. Of these farm units, 126 were in both surveys. Four sizes of farms were selected for analysis, as follows: (1) Less than 60 acres; (2) 60 to 399 acres; (3) 400 to 999 acres; and (4) 1,000 or more acres of cropland per farm.

The hypothesis of this study was that lower direct costs per acre and per unit of output are obtained on large farms. The comparative analysis was restricted to direct costs in conjunction with estimates of growth returns per acre. In calculating per acre returns to land and unpaid labor and management, these estimates provided an indication of the relative returns from the various crop alternatives under existing management practices.

Those farms having more than 400 acres of cropland generally obtained lower direct costs per unit of production and greater returns per acre to land and management than smaller farms. Cotton farms in the Delta with more than 1,000 acres of cropland had little or no direct cost advantages over farms having between 400 and 1,000 acres of cropland. The greatest reductions in direct cost per acre and per unit of output were those between the small and intermediate size groups.

The analysis of highly mechanized enterprises--soybeans, oats, and wheat--showed a fairly consistent relationship between size of farm and net returns to productive factors on

farms having less than 1,000 acres of cropland, but the results varied for cotton. The net return per acre to unpaid labor, land, and management from cotton production was relatively favorable on small farms since unpaid labor constitutes a significant proportion of total inputs. With limited command of resources, most full-time farmers with less than 60 acres of cropland in the Delta maintained little more than a subsistence level of living.

MOS, USDA, Inform. Div., Washington, D.C., 20250.

Vegetable Crops

Zink, F. W., and Yamaguchi, M. STUDIES ON THE GROWTH RATE AND NUTRIENT ABSORPTION OF HEAD LETTUCE. *Hilgardia* 32(11): 471-500. 1962.

The growth rate and nutrient absorption of the Great Lakes variety of lettuce during development for the spring, summer, and fall crops in the Salinas Valley of California was determined. The authors concluded:

1. Great Lakes lettuce developed new leaves at a nearly constant rate from emergence to market maturity.
2. Leaf area per plant increased at a progressively accelerated rate. The rapid increase in leaf area per plant was the result of an accelerated rate of increase in area per leaf, and was not due to rapid increase in leaf number per plant.
3. Correlated with the increase in leaf area was a progressive acceleration in the rate of increase in fresh and dry weight per plant. Great Lakes produced in excess of 70 percent of its fresh weight during the 21-day period preceding first harvest, and in excess of 36 percent of its fresh weight the week before the first harvest.
4. In general, the percent of dry matter decreased as the plant approached market maturity. The fluctuation in dry matter during the growth of some crops was correlated with climatic conditions and/or the irrigation schedule.
5. The Great Lakes variety did not utilize the same amount of heat units to reach market maturity when planted at different times of the year or in different micro-climates on the same date. Lettuce of good quality was produced with a mean temperature in the range of 51° to 67° F. during the head-formation period of growth.
6. Chemical analyses of the plants showed a trend for total nitrogen, phosphorus, magnesium, and sodium to decrease as the plants approached market maturity. The calcium level of the plants remained at a near constant throughout the growth of the crops. The potassium content fluctuated, and no general trend was observed. Nitrate-nitrogen fluctuated throughout the growth of the crops. These fluctuations in nitrate-nitrogen can be related to nitrogen fertilizer application and/or rate of growth.
7. The shape of the nitrogen, phosphorus, potassium, calcium, magnesium, and sodium uptake curves was very similar to that for dry-matter production. Over 70 percent of the nutrient uptake of the crop was absorbed during the 21 days immediately preceding first harvest.
8. From the time of planting to a week after thinning lettuce absorbed less than 2.5 pounds of nitrogen, 1 pound of phosphoric acid, and 4 pounds of potash per acre. By first harvest, the crop had removed an average of 95 pounds of nitrogen, 27 pounds of phosphoric acid, 208 pounds of potash, 9 pounds of sodium, 33 pounds of calcium, and 12 pounds of magnesium per acre.

Agr. Pub., Room 207 U. Hall, 2200 U. Ave., Berkeley 4, Calif.

Jasmin, J. J. and Laliberte, J., ASPARAGUS PLANTING ON ORGANIC SOILS. Amer. Soc. Hort. Sci. Proc. 81: 295-298. 1962.

The best depth and distance of planting in the row for asparagus grown on organic soil was studied over a 4-year period in the southwestern part of Quebec, Canada. Yields, plant population, and depth of crown at the end of the experiment were determined and leaf tissue analyses were made.

Asparagus plants set 9 inches deep were earlier and better yielding than those planted at 12 inches. After 5 years, the crowns set at 9 inches were 7 inches from the surface while those set at 12 inches were 9.1 inches. The depth of planting did not influence the plant mortality nor the total amount of N, P, K, Ca, and Mg present in the leaf tissues. Slightly more K was found in tissues from 9 as compared to 12 inch planting depths.

The distance of planting in the row, and especially the closer planting, had some influence on yield but not on depth of crown nor in the total amount of N, P, K, Ca, and Mg present in the leaf tissues. The plant mortality was influenced by crowding when plants were set at 12 inches in the row. A greater percentage of plants died at closer planting than when set further apart.

Organic Soil Substation Res. Br., Canada Dept. Agr., Ste Clotilde de Chateauguy, Quebec, Canada.

Doolittle, S. P., Taylor, A. L., Danielson, L. L., and Reed, L. B. COMMERCIAL WATER-MELON GROWING. U.S. Dept. Agr., Agr. Res. Serv. Agr. Inform. B. 259, 31 pp. 1962.

A complete "culture and care" publication, including disease and insect control, for the commercial production of watermelons in the United States was given.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Whitaker, T. W., Ryder, E. J., and Hills, O. A. LETTUCE AND ITS PRODUCTION. U.S. Dept. Agr., Agr. Res. Serv. Agr. Hbk. 221, 49 pp. 1962.

Lettuce (*Lactuca sativa* L.) is an important vegetable crop in this country; it exceeds in farm value all fresh vegetable crops except potato and tomato. During the 1950's the acreage for harvest fluctuated between 204,000 and 233,000 acres. The farm value of the crop fluctuated between \$96 million in 1950 and \$142 million in 1957.

This is a complete "culture and care" publication, including disease and insect control, for the production of lettuce in the United States.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

MacGillivray, J. H., Sims, W. L., and Kasmire, R. F. SWEET CORN PRODUCTION IN CALIFORNIA. Calif. Agr. Expt. Sta. C. 515, 22 pp. 1962.

Sweet corn is a warm-season vegetable that has become a staple crop in California. Approximately 22,000 acres are devoted to sweet corn, and annual production averages about 95,000 tons.

Almost the entire crop is for home consumption. Most of it is sold fresh on California markets, a small amount is delivered to freezers. Since sweet corn is highly perishable, long-distance shipment is, on the whole, impractical.

Quality corn in prime condition is readily marketable. While disease and insect pests are a perennial hazard and proper harvesting presents certain problems, these phases of production are not the producer's greatest obstacles. Good quality is not too difficult to achieve; yet much of the corn sold in retail markets is of poor quality--largely because of inadequate cooling and lax handling practices.

The grower's chief problem is to maintain high quality from the time the ears have been harvested until they reach the consumer. To do this, the corn must be adequately cooled and stored at low temperatures.

While better pest control and harvesting practices are always being sought, sweet corn production is most likely to be improved by better ways of handling the ears after harvest.

The methods described in this circular would improve quality considerably. How far growers should go in this direction, however, will depend on economic conditions, the interest and cooperation of people in the trade, and the demands of the consumer.

This is a complete "culture and care" publication on sweet corn production.

Agr. Pub., Room 207 U. Hall, 2200 V. Ave., Berkeley 4, Calif.

Westerhout, J. RELATION OF FRUIT DEVELOPMENT TO THE INCIDENCE OF BLOSSOM-END ROT OF TOMATOES. *Netherland J. Agr. Sci.* 10: 223-234. 1962.

Calcium deficiency in the fruit seems to be the basic cause of blossom-end rot in tomatoes. Even when the soil solution contains an adequate calcium content, calcium-deficiency symptoms may appear in the plant due to a series of factors as growth rate and lack of equilibrium between water uptake and transpiration. The calcium deficiency in the terminal bud has its influence on the availability of calcium to the fruit. It depends on the growth rate of the fruit whether under calcium-deficiency symptoms in the plant blossom-end rot will occur. At a relatively slow development of the fruit, adequate calcium seems to be always available to produce normal fruits, but at a growth rate above a certain level the calcium deficiency will extend to the fruit itself and result in the disorder. An evenly distributed growth rate over the day and night period may also help to prevent calcium deficiency in the fruit.

Research Dept., Lever Plantations in Congo, Valigimba, Congo.

Nelson, D. C., and Nylund, R. E. COMPETITION BETWEEN PEAS GROWN FOR PROCESSING AND WEEDS. *Weeds.* 10: 224-229. 1962.

During the years 1956, 1958, and 1959, competition between peas and white mustard (*Brassica hirta* Moench) and between peas and foxtail millet (*Setaria italica* (L.) Beauv.) was studied. Mustard thinned to uniform stands and allowed to compete all season with peas varied from year to year in its effects on peas. During these 3 years, 3 mustard plants per square foot caused the following reductions: Pea stands, 0 to 25 percent; fresh weights of pea vines, 39 to 71 percent; and yields of shelled peas, 0 to 64 percent. These variations were attributed to differences in relative time of pea and weed emergence, to differences in stage of pea maturity at harvest, and to differences in seasonal rainfall during the 3 years.

In 1956, a population of 27 foxtail plants per square foot caused reductions in vine weights and yields of peas comparable to those caused by 3 mustard plants per square foot. Mustard was more injurious to growth and yield of peas partly because it emerged earlier than foxtail.

Relative time of weed and pea emergence was found to be an important factor in weed-crop competition. When mustard emerged 3 days before peas, fresh weight of pea vines was reduced 54 percent, but when mustard emerged 4 days after peas, the fresh weight of pea vines was reduced only 17 percent.

Competition between peas and weeds was thought to be primarily for light and moisture.

The relative growth rates of peas, white mustard, wild mustard, rough pigweed, lady-thumb, foxtail millet, green foxtail, yellow foxtail, and barnyardgrass grown without intra- or inter-species competition were determined. The growth curves obtained suggest that the Brassica species would be the more severe competitors with peas and that weed competition usually would be more severe in late-seeded than in early-seeded peas.

N. Dak. State U. Fargo, N. Dak.

Zaumeyer, W. J., and Thomas, H. R. BEAN DISEASES--HOW TO CONTROL THEM. U.S. Dept. Agr., Agr. Res. Serv. Agr. Hbk. 225, 39 pp. 1962.

Diseases of beans are causing severe and widespread damage to this valuable crop every year in the United States. In some seasons, they may cost farmers from \$15 to \$20 million.

Some of the common diseases of beans result in death of the young seedlings; some result in injury or death of the growing plants; and some result in spots on pods and seeds that make the product unsalable. Most of the serious bean diseases are caused by parasites--chiefly fungi and bacteria, which cannot be seen without a microscope, and viruses, which cannot be seen even with a compound microscope. Some are caused by such things as extreme heat. Some show that the soil in which beans are being grown contains either too little or too much of one or more minerals.

Methods used to guard bean crops against infection from bean diseases are given. Ways to identify each of the principal bean diseases are given along with the currently used methods of control. Recommended bean varieties that have proved to be immune to certain diseases are discussed.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Cole, G. L. AN ECONOMIC EVALUATION OF THE ALTERNATIVE METHODS OF HARVESTING PEAS AND LIMA BEANS. Del. Agr. Expt. Sta. C. 32, 49 pp. 1962.

Growers and processors were interviewed and harvesting operations were observed during 1959 and 1960 to obtain information on the costs and efficiencies of harvesting peas and lima beans. Investments in vining and other harvesting equipment were determined and labor and machinery requirements for the various harvesting methods were noted. Field losses and quality of the shelled product from different harvesting methods were compared.

The lowest cost method for harvesting peas was the converted mobile viner followed by the commercially built mobile viner. Approximately \$29 per acre, or \$19 per ton, was saved by using the commercial mobile viner at capacity when compared with a double stationary viner with hand feeder. Greater savings were realized when the commercial mobile viner was compared with single stationary viners or double viners with automatic feeders.

Field losses from mobile viners harvesting peas were found to be relatively small (2 to 3 percent). There were no significant differences noted in Tenderometer readings between mobile and stationary vining.

Lima beans were harvested at the lowest cost with the converted mobile viner, followed closely by the commercial mobile viner. However, the commercial mobile viner has a greater season's capacity than does the converted unit. When 75 acres of lima beans were harvested annually, the total cost per acre was \$28.07 for the converted mobile unit, and over \$6 per acre higher for the commercial unit. The double viner with hand or automatic feeder had a total cost in excess of \$50 per acre.

When the commercial mobile viner was used at maximum annual capacity of 150 acres, the total cost was \$21.01 per acre. Stationary viners to harvest this acreage cost at least \$16.09 more per acre, or \$22 more per ton when the beans yielded 0.75 ton per acre.

The commercial mobile viners were not as efficient in harvesting lima beans as they were on peas. Losses averaged 9 percent compared to 5 percent for a double stationary viner.

A major part of the savings from the use of mobile viners for harvesting both crops was due to eliminating loading and hauling the vines to the viner and disposing of the vines.

Adoption of bulk handling techniques for shelled peas and lima beans would result in additional savings.

The use of mechanical snap bean pickers to harvest lima beans cannot be considered economical until modifications are made on the machine to reduce field losses.

U. Del., Agr. Expt. Sta., Newark, Del.

Abel, F. H., Christensen, R. L., and Smith, R. C. AN ECONOMIC ANALYSIS OF QUALITY LOSSES IN THE MARKETING OF DELAWARE POTATOES. Del. Agr. Expt. Sta. B. 343, 30 pp. 1962.

Delaware potato growers suffer large losses each year because of deterioration of potatoes in transit. A comprehensive study was undertaken to determine the causes of these losses and to develop methods to minimize or prevent them. Observations were made on the farm; growers were interviewed; laboratory studies were completed; loads of potatoes were accompanied to destination; and detailed information was obtained on loads of potatoes shipped from Delaware in 1960.

Loads of Delaware potatoes were adjusted or rejected because the potatoes were dirty, bags were short weight, potatoes were out of grade, or potatoes had bacterial soft rot. Bacterial soft rot accounted for about 90 percent of all loads adjusted or rejected. The average loss was 55 cents per hundredweight for all loads adjusted or rejected.

Excess moisture on the surface of potatoes, heat injury, high temperatures, and mechanical injuries all contribute to the problem of losses in summer potatoes. Methods currently used for cooling potatoes are precooling, icing in transit, and mechanical refrigeration in transit. Precooling and mechanical refrigeration were effective in preventing or minimizing losses. Icing in transit was not a satisfactory practice because ice increased the problem of excessive moisture.

Precooling tends to dry potatoes in addition to cooling them. The drying effect of the precooler may be as important or possibly more important, than the cooling effect.

Washing loads of potatoes greatly increased the incidence of loss from bacterial soft rot. If washed loads were precooled, losses from soft rot were reduced substantially.

Losses because of deterioration in the marketing channels can be minimized if producers will use the following recommended practices: (1) Handle potatoes carefully at all times; (2) never expose potato tubers to direct sunlight for more than 15 minutes; (3) ship only sound potatoes; and (4) ship only dry potatoes.

U. Del., Agr. Expt. Sta., Newark, Del.

ECONOMIC AND SOCIAL ASPECTS OF SOIL AND WATER CONSERVATION

Costs and Returns

Soil Conservation. 28(5): 99-119. 1962.

The December issue of "Soil Conservation" is devoted to articles on the economics of conservation practices. The following list presents author, title, and address of author for each article:

1. Dwyer, C. H. BIGGER PROFITS SPUR TO CONSERVATION FARMING. SCS, USDA, Washington, D.C., 20250.
2. Solomon, L. PASTURE-LIVESTOCK BOOST FARM'S INCOME A THIRD. SCS, USDA, Clarksville, Tenn.
3. Blackham, L. B. BANKER "WOULDN'T LEND A RED CENT"--LAND NOW WORTH HUNDREDS OF DOLLARS AN ACRE. SCS, USDA, St. George, Utah.
4. McClellan, J. C. AMERICAN TREE FARM SYSTEM MAJOR CONSERVATION MOVEMENT. Amer. Forest Products Indus., Washington, D.C., 20250.
5. Davison, D. N. GRASS-WATER CONSERVATION BRINGS IDAHO FARMER RESULTS. SCS, USDA, Montpelier, Idaho.
6. Bolar, M. D. ARKANSAS FARMER'S CONSERVATION MONEY-MAKERS. SCS, USDA, Little Rock, Ark.
7. Williams, D. A. ECONOMIC FACTORS ESSENTIAL IN SOUND CONSERVATION. SCS, USDA, Washington D.C., 20250.
8. Tegner, R. F. SNOW SURVEYS MEAN DOLLARS FOR AGRICULTURE AND INDUSTRY. SCS, USDA, Berkeley, Calif.
9. Myers, R. E. CAMPSITE OUTPAYS CATTLE FOR PART-TIME FARMER. SCS, USDA, Batavia, N. Y.
10. Wiltzen, H. A. SWAPPING CROPLAND FOR GRASS "GOOD BUSINESS" IN GREAT PLAINS. SCS, USDA, Malta, Mont.
11. Peavy, B. S. PLANNING FOR CONSERVATION PAYS, TOO! SCS, USDA, Merced, Calif.
12. Barnett, H. T. DEDICATED CONSERVATION BANKER--A PROFILE. (No address given.)
13. Kerr, R. H. \$170,000 SAVING SEEN IN IRRIGATION CANAL LINING. SCS, USDA, Ogden, Utah.
14. Solomon, E. E. ECONOMICAL EROSION CONTROL STRUCTURES REPLACE EXPENSIVE COUNTY BRIDGES. SCS, USDA, Blair, Nebr.
15. Shiflet, T. N. PRIMROSE PATH FOR FLORIDA BEEF CATTLE. SCS, USDA, Lake Charles, La.

Farm Economics Division. CHANGES IN FARM PRODUCTION AND EFFICIENCY: A SUMMARY REPORT. U.S. Dept. Agr., Stat. B. 233, 54 pp. Rev. Sept. 1962.

This is an annual publication designed specifically to present the major statistical series on farm production, production inputs, and efficiency. It provides in one place the latest information for each of the several series that have been developed to appraise such things as changes in production, changes in farm inputs, and practices, improvement in labor productivity, and progress of farm mechanization.

MOS, USDA, Inform. Div., Washington, D.C., 20250.

Brooks, O. L., Beaty, E. R., and McCreery, R. A. COMPARISON OF PELLETTED COASTAL BERMUDAGRASS, AND TWO MIXED RATIONS FOR ANIMAL GAINS AND CARCASS VALUES. Agron. J. 54: 462-463. 1962.

Pelleted Coastal bermudagrass produced rapid steer gains of more than 2 pounds per day. A concentrate ration produced a similar rate of gain and carcasses with higher finish and dressing percent, and required about the same amount of feed per pound of gain. A third treatment consisting of $\frac{1}{2}$ Coastal bermudagrass pellets and $\frac{1}{2}$ concentrates produced the fastest gains and a dressing percent comparable to a higher concentrate ration. This treatment required less feed per pound of gain than either of the other two.

U. Ga., Col. Agr. Expt. Sta., Athens, Ga.

Brown, W. H. PEANUT-COTTON FARMS: ORGANIZATION, COSTS, AND RETURNS, SOUTHERN COASTAL PLAINS, 1944-60. U.S. Dept. Agr., Econ. Res. Serv. Agr. Econ. Rpt. 7, 31 pp. 1962.

The number of field crop and general farms in the southern Coastal Plains reported by the census declined about two-thirds from 1945 to 1959. These are chiefly peanut-cotton farms. The reduction resulted from a decline in the number of sharecroppers, the conversion of small commercial farms into part-time farms and rural residences, farm consolidation, and the changing of some of these farms to other types of commercial farming.

Net farm incomes on peanut-cotton farms varied from a low of \$1,500 per farm in 1946 to a high of \$3,467 in 1958. Net incomes on these farms were generally low compared with incomes on other major types of farms in the United States for which comparable data are available. The return per \$100 invested is as high as on most other farm types, but the size of farm is so small that the annual income is relatively low.

The budget method was used in analyzing the effect of changes in prices, size, organization, and practices on net farm income. Much of the analysis was based on the years 1944 and 1960. The effect of unusual weather was eliminated by normalizing yields in the respective years.

The trend in net farm income was upward from 1944 to 1960. The increase amounted to 107 percent. In dollars of constant purchasing power, however, net farm income increased only 25 percent.

Factors affecting net farm income include prices, increase in size of farm, practices leading to higher yields per acre, mechanization, and changes in relative size of enterprises.

In 1960, prices received were 22 percent above those in 1944 but 12 percent below prices in 1947-49. Prices paid for items used in production were 35 percent higher in 1960 than in 1944.

From 1944 to 1960, estimated normal yields of peanuts, cotton, and corn increased 51, 75, and 129 percent, respectively. This increase in yields was made possible by: Development of new varieties and strains of seed; new pesticides; better methods of disease control; increased use of fertilizer; better land selection; and other improved practices.

From 1944 to 1960, tractor power replaced nearly all the mule power used in pre-harvest field operations. By 1957, 60 percent of the peanuts were picked with combines and 20 percent of the corn was picked mechanically.

From 1944 to 1960, average total land farmed increased from 110 to 177 acres, or 51 percent. Total inputs increased 66 percent.

From 1944 to 1948, the acreage of peanuts was unusually high. This was due at least partly to war and postwar demands for oil. After allotments on peanut acreages were re-established in 1949, the acreage of cotton increased nearly as much as the acreage of peanuts declined. In 1954, cotton acreage allotments were reestablished.

With 1960 prices and cost rates, the shift from cotton and peanuts to corn and livestock tended to lower net farm income and net farm production and to increase total cost per unit of production.

One estimate of the influence of factors on net farm income attributed 61 percent of the increase from 1944 to 1960 (with normal yields) to increased efficiency, 15 percent to prices, and 24 percent to increased size (total inputs).

From 1944 to 1960, purchased inputs increased from 48.5 to 66.6 percent of total inputs.

Since 1948, the value of land and buildings per acre has risen more than has net farm income. But the net farm income had been high enough to return more than the mortgage rate of interest to all capital (including land) and to allow the operator and his family a return equal to the wage rate for hired labor.

Inform. Div., MOS, USDA, Washington, D.C., 20250.

Hawkins, H. D., and Suter, R. C. DAIRY CATTLE; BUDGETED COSTS AND RETURN FOR VARIOUS SYSTEMS OF MANAGEMENT. Purdue Agr. Expt. Sta. Res. B. 743, 19 pp. 1962.

New technology has led to many changes on dairy farms. During the last decade, large amounts of capital have been added to the farm family business. Herd size and production rates have been increased. Yet, the size of the labor force has remained constant. The new technologies have had a tendency to upset the traditional combinations of resources and methods of production. Not all dairy farmers have kept up; some have only partially adopted new technology; and others have fabricated entire packages of new technology.

Twelve different systems of enterprise management as they exist on dairy farms today were developed. These systems were not necessarily the least-cost combinations of resources; instead they more nearly represent optimum combinations of resources or typical patterns of enterprise management, each for a specified level of management.

Four systems used stanchion barns. Eight systems used loose housing and a milking parlor, one of which was a modified parlor built with stanchions, and three of which were herringbone parlors.

Level of management varied widely with corresponding variations in the number of cows kept, the milk produced per cow, and the labor requirements per cow. The scale relationship with almost simultaneous increases in level of management, number of cows, and milk per cow was one which might normally be expected.

Capital investments in buildings and equipment varied with the actual housing and equipment used and were based on 1957-1958 capital outlays. At the 22- to 24-cow level there was no particular difference in the investment in buildings and equipment per cow. When the enterprise size was expanded to 36 or more cows the milking parlors showed a decided advantage.

Average labor requirements per cow were considerably less with the milking parlor systems than with the stanchion barns; hours per cow also declined appreciably as number of cows increased. However, the level of management had to increase also.

The dollar returns to labor and management increased as more technologies were used, as additional capital was substituted for labor, and enterprise size increased. It took a combination of a large number of high producing cows and a conservative capital investment to maximize income. The highest returns per hour were obtained on the enterprises with 36 or more cows where 11,000 or more pounds of milk was sold per cow, and where the investment in buildings and equipment was limited to \$450 per cow or less. The 75-cow herd did not return as much as the 48-cow herd primarily because the latter was a low-cost operation.

Success or failure, in terms of the dollar returns to labor and management, hinged, to a large extent, on physical coefficients (amounts of resources used), the production rates, the cost data, and on prices. Within any given system of management, success depended on the management factor itself. The variations here lead to variations in results within any one system, which are far greater than the differences between systems.

As technologies are added, there is more opportunity for managerial reward; however, there is also more opportunity for things to go wrong. As enterprise size is increased the opportunity to become more efficient is present; however, the opportunity to become more inefficient is also available.

A skilled manager today is one who: (1) Analyzes his resources and the alternatives available to him; (2) decides on the technologies, on the system of management, and on the herd size he'd like to have; and (3) makes that particular combination of resources and system of management work whenever he adopts it to his advantage.

Tables.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Institutional, Educational, and Social Factors Affecting Conservation Farming

Irwin, G. D., and Baker, C. B. EFFECTS OF LENDER DECISIONS ON FARM FINANCIAL PLANNING. Ill. Agr. Expt. Sta. B. 688, 27 pp. 1962.

For the credit dependent farmer, lender behavior may well limit farm planning. If the lender is concerned with the safety of loans made, differential loan limits should be expected with respect to proposed use of funds, depending on whether the input to be purchased can serve as collateral for the loan. Consequently, the optimal planning by the farmer, as well as level of income he gets, will be affected by lender limits. This study investigated such lending limits and the farm organizational effects of adjusting to them.

A hypothetical farm situation was developed from farm records for a cash-grain and a livestock farm in terms of financing statements, physical inventories, production plans, and personal characteristics of the farm operator and his family. The cash-grain farm and the livestock farm were made as similar as possible, except for the setting in different areas of the state.

The lender survey indicated that loans to create assets (feeder cattle, machinery, or buildings that furnish chattle security) were granted in significantly larger amounts than were loans for purposes that do not create pledgeable assets (fertilizer or operating expense). Livestock-area lenders made larger loans for feeder cattle and machinery. Grain-area lenders made larger loans for buildings and fertilizer. Loans to finance operating expenses were similar between areas.

A procedure incorporating both production and financial decisions and using results from the lender survey was then used to deduce the consequences of various types of lender limits. Nine plans were computed for each area with varying overall lender optimism (as reflected in maximum size of loan obtainable) with differing degree of seasonal demands for cash. Comparisons were made to suggest the importance of lender influence and of seasonal considerations in the situations under study.

In the first seven plans for each area, the optimum organizations were dominated by adjustments to meet heavy fixed commitments on real estate and machinery loans. These requirements forced a buildup of cash balances, thus subjecting the operator to lender limits that necessitated borrowing to meet a part of the operating requirements. Grain sale

was necessary to help meet debt payments. Cattle numbers were limited because funds from corn were too valuable in other uses. Operating expenses were treated as seasonally fixed, and thus had first claim on borrowing capacity, cash on hand, and cash income in previous quarters. In situations that allow borrowing in excess of these needs, the choice between cattle and fertilizer depended on a relationship between corn supplies, loan terms available, and the amount of fixed commitments to be met in the following quarters.

Lender decisions influenced both the choice of enterprises and the handling of financial accounts. Where lender differentiations were high or loan limits were low, the situation became financially insolvent. Where lender differentiations were low, it was most profitable to fertilize at an intermediate level. In all cases the combination of higher differentiation between purposes and heavy necessary borrowing for operating expenses so used up borrowing capacity that the remaining borrowing could be used more profitably for cattle.

Changing fixed debt payments allowed enlarging the enterprises, but did not change the ones chosen in the optimum plans. Reducing fixed commitments in critical periods decreased the need to borrow for operating expense, and also the need to seed corn. As a result, borrowing capacity was less critical as a restraint on the decision to buy more cattle. Timing of debt payments was found critically important for financial success. An important final conclusion is that marginal productivities associated with the use of owned funds are not appropriate for fund allocation decisions with the use of borrowed money, if lender discounts are met such as those found in this study. If other terms, (interest rate, length of loan) vary with purpose, this also would affect optimum allocation of resources.

U. Ill., Agr. Expt. Sta., Urbana, Ill.

Alverson, K. A. SOIL CONSERVATION IS EASY IF YOU DO IT WITH A PLAN ONE STEP AT A TIME. U.S. Dept. Agr. Soil Conserv. Serv., PA-501, 8 pp. illus. 1962.

Work is always easier when: (1) We enjoy doing it; (2) we treat it as a challenge; and (3) we break big jobs into little jobs. That's the way it is with soil and water conservation.

It's easy to become a successful conservation farmer. You don't have to upset your entire operation. Take it one step at a time. In fact, it's better to do it that way provided you work toward the goal of a conservation plan that is best for you and for the land.

A man learns to crawl before he learns to walk and learns to walk before he learns to run. The same is true in soil and water conservation. We can reach our goal by taking just one step at a time if: (1) We know the best place to start and what really pays off; (2) we adopt practices that need doing first and that will fit right into a good conservation plan; and (3) we don't fool ourselves into thinking we are doing a complete job of conservation practices.

SCS, USDA, Inform. Div., Washington, D.C., 20250.

Soil Conservation. 28(2): 27-48. 1962.

The September issue of "Soil Conservation" is devoted to articles on conservation management. The following list presents author, title, and address of author of each article:

1. Williams, D. A. THE BROADENING CHALLENGE OF SOIL AND WATER CONSERVATION. SCS, USDA, Washington, D.C., 20250.
2. Kelley, C. "TWICE AS MANY COWS TWICE AS EASY". SCS, USDA, Lacrosse, Wash.

3. McKeever, I. TERRACING--OLD PRACTICE GOES MODERN. SCS, USDA, Harrisburg, Pa.
4. Thomas, C. H. "CRAWDADS" ARE CRAYFISH-AND VICE VERSA. SCS, USDA, Crawley, La.
5. Goodlett, W. S., Jr. 5 DISTRICT SUPERVISORS--5 GREAT PLAINS CONTRACTS. SCS, USDA, Big Springs, Tex.
6. Ebert, E. E. THE "SECOND FRONTIER" TODAY. SCS, USDA, Neward, Ohio.
7. Murray, G. E. INTENSIVE PASTURE MANAGEMENT PAYS \$. SCS, USDA, Salt Lake City, Utah.
8. McCalla, T. M. MICROORGANISMS AND THEIR ACTIVITY IN THE SOIL. SWCRD, ARS, USDA, Lincoln, Nebr.
9. Shiflet, T. N., and Harris, C. L. FFA BOYS GET LOWDOWN ON WOODLAND-RANGE CONSERVATION. SCS, USDA, Lake Charles, La.
10. Summers, A. B., and Thorud, O. M. TRUCK CROP-BERRY FARM TURNS TO GRASS. SCS, USDA, Boring, Oreg.
11. Wrenn, E. JAPANESE CONSERVATION SUCCESS STORY. SCS, USDA, Reno, Nev.
12. Williamson, A. D., and Simmons, E. R. OLD PLANT PLAYS NEW ROLE. SCS, USDA, Richmond, Va.
13. Redene, W. H. FAMILY AND NEIGHBORS ENJOY FARM POND. SCS, USDA, Auburn, Nebr.
14. Herbert, F. W. EZRA BRIGGS--GOPHERS STARTED HIM OUT--A PROFILE. (No address given.)
15. Huges, H. M. KNEE DEEP IN TREES. SCS, USDA, Hays, Kans.
16. Mills, R. OHIO EAGLE SCOUT WINS HIGH CONSERVATION AWARD. SCS, USDA, Bucyrus, Ohio.
17. Freeman, O. L. MULTIPLE USE: A CONCEPT FOR PRIVATE LAND--EXCERPTS FROM TALK BY ORVILLE L. FREEMAN AT WHITE HOUSE CONFERENCE AT WASHINGTON, D.C. MAY 24, 1962. Sec. Agr. Washington, D.C., 20250.

Soil Conservation. 27(10): 219-240. 1962.

The May issue of Soil Conservation is devoted to articles on conservation needs. The following list presents author, title, and address of author for each article presented:

1. Williams, D. A. CONSERVATION NEEDS MEASURED. SCS, USDA, Washington, D.C., 20250.
2. Barnard, J. W. 30,000 PEOPLE HELPED MEASURE NATION'S CONSERVATION JOB AHEAD. SCS, USDA, Washington, D.C., 20250.
3. Green, T. C., and Neubauer, T. A. NEEDS INVENTORY--FACELIFTING R_x FOR MANMADE WRINKLES ON THE LAND. SCS, USDA, Washington, D.C. 20250.
4. Ford, C. W. KENTUCKY WATERSHED FARMERS COUNT ON "NEEDS" INFORMATION. SCS, USDA, Russellville, Ky.
5. Hill, E. WISCONSIN SHOWS HOW NEEDS REPORTS CAN BE USED. SCS, USDA, Madison, Wis.
6. Roth, B. A., and Laramy, R. E. THE FACE OF RHODE ISLAND A DOZEN YEARS HENCE. SCS, USDA, Upper Darby, Pa.
7. Larson, C. ACP AIMS AT CONSERVATION NEEDS TARGETS. ASCS, USDA, Washington, D.C., 20250.
8. Warnken, A. D. CALIFORNIA FARMERS HAVE SYSTEM FOR MEETING CONSERVATION NEEDS. SCS, USDA, Sacramento, Calif.

9. Luker, C. GREAT PLAINS PINPOINTS CONSERVATION NEEDS. SCS, USDA, Washington, D.C., 20250.
10. Archer, S.G. CONSERVATION NEEDS FIGURES WELCOMED IN CAROLINAS. SCS, USDA, Spartanburg, S.C.
11. Grogger, H. E. A CITY LOOKS TO THE SOIL. SCS, USDA, Columbia, Mo.
12. Bedell, G. MICHIGAN COUNTIES USE SOIL SURVEYS TO MEASURE CONSERVATION NEEDS. SCS, USDA, Jackson, Miss.
13. Johnson, M. L. WATERSHED RESEARCH FOR THE NORTHEAST POINTS UP WATER CONSERVATION NEEDS. SCS, USDA, Danville, Vt.
14. Brower, F. R. CONSERVATION NEEDS INFORMATION SPEEDS RIVER BASIN PLANNING. SCS, USDA, Athens, Ga.
15. Kennedy, J. F. EXCERPTS FROM PRESIDENT'S MESSAGE TO CONGRESS ON CONSERVATION. February 28, 1962. Washington, D.C.

Soil Conservation. 27(11): 243-263. 1962.

The June issue of "Soil Conservation" is devoted to articles on the history of soil conservation. The following list presents author, title, and address of author for each article:

1. Williams, D. A. SOIL AND WATER PROBLEMS CONCERN FOR TWO CENTURIES. SCS, USDA, Washington, D.C., 20250.
2. Buie, T. S. CONSERVATION FARMING OVERCOMES SOUTHEAST'S CENTURIES OLD PROBLEMS. SCS, USDA, Columbia, Mo.
3. Tagner, R. F. AFTER A CENTURY NEW GENERATION TAKES OVER. SCS, USDA, Berkeley, Calif.
4. Easton, G. W. A HALF-CENTURY OF SOIL STEWARDSHIP BY THIS WISCONSIN FAMILY. SCS, USDA, Lancaster, Wis.
5. Weaver, M. M., and Leiby, M. G. FARMING HISTORY IN OLD TILE. SCS, USDA, Waterloo, N.Y.
6. Jones, M., CONSERVATION LEGISLATION SPARKED BY "DUST BOWL". Chief Judge, U.S. Court of Claims.
7. Barre, R. C. OCTOGENARIAN "VILLAGE BLACKSMITH" FORGES CONSERVATION LINKS. SCS, USDA, Hillsboro, Ohio.
8. Garvey, G. D. CENTENNIAL OF STRIPCROPPING. SCS, USDA, LaCrosse, Wis.
9. Carlson, C.W. SOIL AND WATER RESEARCH SPANS A CENTURY. SWCRD, ARS, USDA, Beltsville, Md., 20705.
10. Rose, C.A. GRASS ALONG THE BITTERROOT. SCS, USDA, Hamilton, Mont.
11. Holeman, J. N. CONSERVATION HELPS LICK SEDIMENTATION BUGABOO. SCS, USDA, Beltsville, Md., 20705.
12. Bennett, D. A. OLD FARM STAYS PROUDLY ON IN MEGALOPOLIS' PATH. SCS, USDA, ROCHESTER, N.H.

Soil Conservation. 27(12): 267-288. 1962.

The July issue of "Soil Conservation" is devoted to articles on conservation education. The following list presents author, title and address of author for each article:

1. Williams, D. A. CONSERVATION EDUCATION IN THE CLASSROOM AND AFIELD. SCS, USDA, Washington, D.C., 20250.

2. Brown, R. S. TEACHING TEACHERS TO TEACH RESOURCE CONSERVATION. SCS, USDA, Columbus, Ohio.
3. Sisk, L. J. STAR FARMER OF AMERICA SCHOOLED IN CONSERVATION. SCS, USDA, Spartanburg, S.C.
4. Evans, C. A. 2,000 NORTH DAKOTA TEACHERS STUDY CONSERVATION. SCS, Bismark, N. Dak.
5. Miller, S. 10 MILLION YOUNG CONSERVATIONISTS. National Audubon Soc., New York, N.Y.
6. Davis, D. O. TEACHER CONSERVATION INSTITUTES BRING COUNTY PEOPLE TOGETHER. SCS, USDA, Denver, Colo.
7. Beard, J. C. "WE PLEDGE OURSELVES". SCS, USDA, San Benito, Tex.
8. Pettit, T. S. BOY SCOUT NATURE MUSEUM OUTDOOR CONSERVATION CLASSROOM. Director of Conservations, Boy Scouts of America, New Brunswick, N.J.
9. Schweers, M. MILWAUKEE SCHOOLS GO ALL OUT FOR CONSERVATION TEACHING. SCS, USDA, Madison, Wis.
10. Emerson, A. W. CONSERVATION TEACHING GEARED TO EVERYDAY COMMUNITY LIFE. SCS, USDA, Berkeley, Calif.
11. Woodard, J. L. and Dondero, L. J. KIDS' CARTOONS LIVEN CONSERVATION INTEREST. SCS, USDA, Bennington, Vt.
12. Bliss, M. E. A WOMAN'S WAY IN CONSERVATION EDUCATION. SCS, USDA, Milwaukee, Wis.
13. Bureau, M. F. FROM BACKYARD GARDEN TO CONSERVATION TRUCK FARM. SCS, USDA, Wooster, Ohio.
14. Bohnenblust, G. F. and Holmes, D. E. CONSERVATION INCREASED THROUGH CONSERVATION TEACHING. SCS, USDA, McPherson, Kans.
15. Batson, G. TV BRINGS CONSERVATION INTO TENNESSEE CLASSROOMS. Television Teacher, Nashville, Tenn.
16. Selke, G. A. OUR JOB AND YOURS. Ass't. to Sec. of Agr., Washington, D.C., 20250.

Soil Conservation. 28(4): 75-96. 1962.

The November issue of "Soil Conservation" is devoted to the relationship of the businessmen and soil conservation. The following list presents author, title, and address of author for each article:

1. Garver, W. E. THE BUSINESSMAN AND CONSERVATION. Agr. and Nat'l Resources Dept., Chamber of Com., Washington, D.C., 20250.
2. Jones, H. I. SOIL SURVEYS SAVE MONEY FOR CITY OF THE ALAMO. SCS, USDA, Denver, Colo.
3. Yusk, S. FIELD NUMBER SIGNS SOLVE PROBLEM OF CONSERVATION MANAGEMENT BY MAIL. SCS, USDA, Dixon, Tenn.
4. Brown, H. R. BANKERS SCORE IN KANSAS GRASSLAND MANAGEMENT. SCS, USDA, Hays, Kans.
5. Gilliam, L., and Emerson, A. W. CITY KIDS HAVE BIG WEEKEND ON OREGON FARMS. SCS, USDA, Condon, Oreg.
6. Tootell, D. BUSINESSMEN SPONSOR ANNUAL SCD DAY. SCS, USDA, Helena, Mont.
7. Klein, W. J. FARM EQUIPMENT INDUSTRY INVESTS HEAVILY IN FURTHERING SOIL AND WATER CONSERVATION. Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

8. Loucks, C., Zimmerman, C. H., and Moorefield, G. BUSINESS CONSERVATION AWARDS SYMBOLIZE FARM-CITY TEAMWORK. SCS, USDA, Ruby, N. Dak.
9. Carlson, L. H. WATERSHED PROJECT SAVES CEDAR CITY DOLLARS. SCS, USDA, Cedar City, Utah.
10. Atkinson, W. H. NONFARMERS SIZE UP SOIL AND WATER CONSERVATION. SCS, USDA, Carlsbad, N. Mex.
11. Price, G. J. TAILOR-MADE--CLOTHING AND CONSERVATION. SCS, USDA, Burley, Idaho.
12. Konieczny, E. G. CONSERVATION DRAINS SPELLS END TO "TOWN'S" OLD FASHIONED DIGGING BEES. SCS, USDA, Greenfield, Mass.
13. Anonymous--D.C. METROPOLITAN SMALL-WATERSHED PROJECT.
14. Freeman, O. L. AGRICULTURE AND BUSINESS-EXCERPTS FROM ADDRESS BY SECRETARY OF AGRICULTURE ORVILLE L. FREEMAN BEFORE THE SALES EXECUTIVE CLUB OF NEW YORK, MARCH 27, 1962. Sec. Agr. Washington, D.C., 20250.
15. Lowerly, R. W. MICHIGAN CITY AND FARM INTERESTS JOIN HANDS IN WATERSHED--RECREATION--WILDLIFE DEVELOPMENTS. SCS, USDA, Marshall, Mich.

Soil Conservation 28(1): 3-23. 1962.

The August issue of "Soil Conservation" is devoted to articles on soil conservation around the world. The following list presents author, title, and address of author for each article:

1. Williams, D. A. CONSERVATION IS INTERNATIONAL. SCS, USDA, Washington, D.C., 20250.
2. Harrison, P. SOIL CONSERVATION AROUND THE WORLD. SCS, USDA, Washington, D.C., 20250.
3. Sanders, R. W. KEY CONSERVATION TO WORLDWIDE PEACE HOPE. SCS, USDA, Waterboro, S.C.
4. Rogers, J. B. and Shields, L. B. TRAINING FOR CONSERVATION IN MANY LANDS. SCS, USDA, Washington, D.C., 20250.
5. Archer, S. G. YUGOSLAVIANS TAKE HOME CONSERVATION FINDINGS. SCS, USDA, Spartanburg, S.C.
6. Young, G. EDUCATION AND SKILLS KEY TO WORLD RESOURCES--FOOD DEVELOPMENT. SCS, USDA, Washington, D.C., 20250.
7. Elizalde, R. M. SPAIN'S CONSERVATION PROGRAM MAKES RAPID STRIDES. Chilean Conservation Writer.
8. Kellogg, C. E. SOIL SURVEYS BASIC THROUGHOUT THE WORLD. SCS, USDA, Washington, D.C., 20250.
9. Bennett, J. FROM THE ENDS OF THE EARTH--THEY LEARN ABOUT CONSERVATION AND AMERICANS. SCS, USDA, Athens, Ga.
10. Landon, I. K. SOIL CONSERVATION STICKS IN TAIWAN AND BURMA. Former Soil Conservation Advisor, Agency for International Development.
11. Van Dersal, W. R. 3 WAYS TO CONSERVATION--CANADA--NEW ZEALAND--UNITED STATES. SCS, USDA, Washington, D.C., 20250.
12. Thompson, M. M. ASIA'S GOLDEN RAIN TREE GOES TO COLLEGE. SCS, USDA, Fulton, Mo.
13. Priest, J. E. SNOW SURVEYS IN WEST PAKISTAN. Harza Engineering Co., Lahore, West Pakistan.

Journal of Soil and Water Conservation. "CONSERVATION--A KEY TO WORLD PROGRESS". J. Soil and Water Conserv. 17: 243-269. 1962.

A timely series of related articles that emphasize the natural resource conservation efforts and problems in many countries of the world. The following list presents author, title, and address of author for each article:

Hockensmith, R. D. CONSERVATION--INGREDIENT OF WORLD PEACE AND PROGRESS. SCS, USDA, Washington, D.C., 20250.

Ioanes, R. A. LAND RESOURCES AND LIVING REQUIREMENTS. FAS, USDA, Washington, D.C., 20250.

Barnea, J. WATER FOR WORLD NEEDS. Nat'l. Resources Development Group. United Nations, N.Y., N.Y.

Williams, D. A. LESSONS IN LAND USE. SCS, USDA, Washington, D.C., 20250.

PATTERNS OF PROGRESS IN SOIL CONSERVATION: A SYMPOSIUM.

Pleva, E. G. IN THE ANGLO-AMERICAN COUNTRIES. U. OF Western Ontario, London, Ontario, Canada.

Cavalcanti, A. CONSERVATION PROGRAM IN LATIN AMERICA. U.S. - Brazil OFF. Agr., Rio de Janeiro, Brazil.

Rajan, S. V. G. CONSERVATION AGENCIES IN INDIA. Soil Survey Officer, Indian Res. Inst., New Delhi, India.

Koehler, W. CONSERVATION EFFORTS IN EUROPE. Forestry Sec., Embassy Fed. Republic Germany, Washington, D.C., 20250.

Karaelmas, A. THE CONSERVATION MOVEMENT IN TURKEY. Ministry of Agr., Ankara, Turkey.

Harrison, P. O. SOIL AND WATER CONSERVATION IN MANY COUNTRIES. U.S. Dept. Agr., Soil Conserv. Serv. Misc. P. 908, 31 pp. 1962.

This picture book is intended to tell in a small measure the story of soil and water conservation around the world.

The pictures come from many countries. Better than words they reflect the richly rewarding quarter of a century just ended--the quarter century of the development and spread of modern conservation as the good way of using land.

SCS, USDA, Inform. Div., Washington, D.C., 20250.

Task Force. RURAL RECREATION, A NEW FAMILY-FARM BUSINESS. U.S. Dept. Agr., Report of Task Force on Income Producing Recreation Enterprises on Farm Land. 56 pp. (unnumbered) \$0.25. Sept. 1962.

The development of rural recreation facilities on private land is now firmly established as a part of the Department of Agriculture's program to increase farm income and promote orderly land use adjustment in response to new forces in rural America.

There is a pressing need in the United States for increased recreation areas and facilities. The Nation's farm and ranch land can provide a large part of that need, with income to owners and satisfaction to users.

With the single exception of hunting, the traditional places for outdoor recreation and vacations have been on public land and at commercial resorts. In recent years, the developed capacity of public parks and forests to accommodate the growing demand has been fully taxed. The situation worsens each season.

At best, public facilities serve only a part of the need. Much of our population lives too far away to use them with convenience. Further, many people seek a more quiet and private form of recreation away from the crowds. An answer to this problem lies on our vast and varied farm and ranch acreage which, including private woodlands, constitutes nearly 70 percent of all our land.

Farmers and ranchers are already providing some commercial recreation facilities to the public. The leasing of deer-hunting privileges on farms and ranches, fee fishing in farm ponds, and ski tows are examples of recreation as an added farm business. In some cases, farms have been converted wholly to serving the recreation trade, as, for example, the large number of "hunting preserves" for shooting stocked game birds that have sprung up in recent years.

The U.S. Department of Agriculture is vitally interested in the recreation business on farms for four primary reasons: (1) It offers a chance to provide additional income to farmers and associated businesses and, at the same time, enables farmers to stay on their farms; (2) it can aid in diverting cropland to a more remunerative use for the owner which can later, if and when needed, be returned to cultivation; (3) it provides an urgently needed service; and (4) it helps stabilize the local economy and strengthen social institutions without removing land from private ownership or reducing the tax base.

For sale by Supt. Doc., U.S. Government Printing Off., Washington, D.C., 20402.

BIOLOGY

Fish

McIntire, C. D., and Bond, C. E. EFFECTS OF ARTIFICIAL FERTILIZATION ON PLANKTON AND BENTHOS ABUNDANCE IN FOUR EXPERIMENTAL PONDS. Trans. Amer. Fisheries Soc. 91: 303-312. 1962.

Effects of phosphorus and nitrogen fertilizers on the abundance of fish food organisms were investigated in four newly excavated ponds. Before fertilization the ponds were characterized by low nitrogen and phosphorus concentrations, pH values near neutrality, low total alkalinities, and dissolved oxygen concentrations near saturation. After fertilizers were added to three ponds, chemical and physical conditions were altered considerably by the production of large quantities of plankton organisms. Establishment of plankton populations were followed by development of benthic communities, especially in the two ponds receiving both nitrogen and phosphorus. The benthic community developed most rapidly, and the biomass became greatest in the pond receiving the heaviest applications of nitrogen and phosphorus. In ponds which received no phosphorus, benthic production was low.

Oregon State U., Dept. of Fish and Game Mangt., Corvallis, Oregon.

Moss, D. D., and Scott, D. C. DISSOLVED-OXYGEN REQUIREMENTS OF THREE SPECIES OF FISH. Trans. Amer. Fisheries Soc. 90: 377-393. 1961.

Critical dissolved-oxygen levels and standard metabolic rates were determined for the bluegill (Leponis macrochirus); largemouth bass (Micropterus salmoides); and the channel catfish (Ictalurus punctatus) at 25° C., 30° C., and 35° C. Two types of experiments were conducted: Shock tests in which the dissolved oxygen was dropped rapidly from near saturation to a critically low point; and acclimation tests in which the dissolved oxygen was lowered gradually over a longer period of time. The minimal dissolved oxygen survived by fish in acclimation tests was lower than the survived in shock tests at any given temperature. In shock tests the minimum dissolved oxygen survived by bluegills was 0.75 p.p.m. at 25° C., 1.00 p.p.m. at 30° C., and 1.23 p.p.m. at 35° C. Slightly higher values were obtained for the largemouth bass at all three temperatures and for the channel catfish at 25° C. and 30° C. At 35° C. the channel catfish was more tolerant of low dissolved oxygen than either the bluegill or largemouth bass. In the acclimation tests the critical oxygen values obtained for bluegills were 0.70 p.p.m. at 25° C., 0.80 p.p.m. at 30° C., and 0.90 p.p.m. at 35° C. With the exception of the channel catfish at 35° C., slightly higher values were obtained with the largemouth bass and channel catfish. Within each species there was little difference between standard metabolic rates at the three temperatures. The standard metabolic rate of the bluegill at 25° C. was lower than that of the other species at the same temperature. Bluegills and largemouth bass weighting more than 15 grams showed no change in metabolic rate with increasing size, but below this weight, metabolic rate varied inversely with weight.

U. Ga., Athens, Ga.

Brown, E. H., Jr. MOVEMENT OF NATIVE AND HATCHERY-REARED GAME FISH IN A WARM-WATER STREAM. Trans. Amer. Fisheries Soc. 90: 449-456. 1961.

Movement of 248 marked and recaptured native smallmouth bass (Micropterus dolomieu), native rock bass (Ambloplites rupestris), and hatchery smallmouth bass released in a headwater tributary of the Little Miami River of Ohio during 1953 through 1957 was described. More than 91 percent of the native fishes of both species reported by anglers were taken within $\frac{1}{2}$ mile of release points. Recaptures made with electric shocker and hoop nets indicated that appreciable numbers of native fish remained within limited areas of one to several pools between successive years. Considerable numbers of stocked smallmouth bass moved away from release points. A total of 35.7 percent of fish stocked in optimum habitat in 1953 and later recovered by anglers had moved distances greater than $\frac{1}{2}$ mile. All fish stocked in submarginal habitat upstream in 1955 and later recovered by anglers moved more than $\frac{1}{2}$ mile. Except for one recapture 6 miles upstream from the release point, all returns of stocked fish were from downstream at distances ranging up to 70 miles. The proportion of fish stocked in optimum habitat in 1953 and recaptured 11 to 50 miles downstream increased significantly from 1953 to 1954, suggesting a progressive downstream dispersal. Movement of hatchery smallmouth bass was independent of size at stocking in 1953. Rapid disappearance of the 1953-stocked fish may have resulted from higher mortality, as well as from movement.

Ohio Dept. Nat'l. Resources, Div. Wildlife, Columbus, Ohio.

Cooper, E. L. GROWTH OF WILD AND HATCHERY STRAINS OF BROOK TROUT. Trans. Amer. Fisheries Soc. 90: 424-438. 1961.

Various growth characteristics of the brook trout (Salvelinus fontinalis) were investigated by comparing the performance of three wild populations with five hatchery groups. Wild populations attained a total length at the end of 2 years of about 6 inches, which was less than half the size of the hatchery trout in the same period. Hatchery fish were of the order of 10 x the weight of wild fish. Unfavorable temperature and lack of food were chief causes of slow growth of wild populations. Among the hatchery groups, inbreeding caused a decrease in growth. Randomly bred groups were very similar in size at all times up to 20 months of age. Growth rates of brook trout decline rapidly with increase in length or weight. Total length does not increase exponentially over long time periods, but growth in length more closely approximates a linear series with time. Different mathematical models were applied to growth data from the hatchery groups. The Walford-Ford concept was not applicable because the predicted ultimate sizes of the groups were unrealistic. The concept of Parker and Larkin appeared to describe adequately the growth curves obtained and was useful in measuring differences due to genetic factors. Weight-length curves were similar for fish of different strains grown under similar environmental conditions. Inbred groups had markedly different weight-length curves from those of randomly bred groups. A modification of LeCren's relative condition factor, derived from the weight-length data of the hatchery groups of brook trout, is proposed. It compares the observed weight of a fish with the weight expected to promote the optimum rate of growth of the species. Examples of its use for wild and hatchery groups are given.

Pa. State U., University Park, Pa.

Saunders, J. W., and Smith, M. W. PHYSICAL ALTERATION OF STREAM HABITAT TO IMPROVE BROOK TROUT PRODUCTION. Trans. Amer. Fisheries Soc. 91: 185-188. 1962.

Thirteen dams, twelve deflectors, and several covers were constructed in a 450-yard section of Hayes Brook, Prince Edward Island, to create suitable hiding places for brook trout, (Salvelinus fontinalis Mitchill). In the following year the standing crop of fingerlings (age 0) was above average. The numbers of age 1 and older trout were approximately doubled. The alterations had no noticeable effect on the growth of trout.

Fisheries Res. Board Canada, Biol. Sta., St. Andrews, New Brunswick, Canada.

Webster, D. W. ARTIFICIAL SPAWNING FACILITIES FOR BROOK TROUT (SALVELINUS FONTINALIS). Trans. Amer. Fisheries Soc. 91: 168-174. 1962.

Lack of suitable conditions for natural spawning is a limiting factor in brook trout production in waters in the Adirondack Mountains, New York. Presence of ground water or springs is considered a major requirement for successful spawning in this species. Two kinds of improved spawning areas have been offered: (1) Replacement of unsuitable bottom material with gravel on or near known natural spawning areas; and (2) piping and dispersing water through a gravel-filled box. Both types of improvements have been used by brook trout under some conditions.

Cornell U., Ithaca, N.Y.

McFadden, J. T., and Cooper, E. L. AN ECOLOGICAL COMPARISON OF SIX POPULATIONS OF BROWN TROUT (SALMO TRUTTA). Trans. Amer. Fisheries Soc. 91: 53-62. 1962.

Estimates of population density of all species of fish except the slimy sculpin were made in selected areas of three hard-water streams and three soft-water streams in Pennsylvania. Total standing crops ranged from 46 to 354 pounds per acre. Brown trout (Salmo trutta) stocks ranged from 13 to 137 pounds per acre. Average annual survival of brown trout ranged from 0.189 to 0.554. Recruitment appeared to be fairly stable except for occasional variations believed caused by flood or drought conditions. Growth rate of brown trout was significantly correlated with specific conductance of the water. The data suggest also that a relationship may exist between specific conductivity and standing crop of fish expressed in pounds per acre.

Pa. State U., University Park, Pa.

Coble, D. W. INFLUENCE OF WATER EXCHANGE AND DISSOLVED OXYGEN IN REDDS ON SURVIVAL OF STEELHEAD TROUT EMBRYOS. Trans. Amer. Fisheries Soc. 90: 469-474. 1961.

A field study of spawning gravel conditions affecting the survival of steelhead (Salmo gairdneri Richardson) embryos was conducted in two small streams in the Alsea River Basin in Lincoln County, Oregon, from February to June 1959. Holes 10 inches deep, approximating natural redds, were dug in arbitrarily selected spawning locations. Plastic mesh sacks containing gravel and 100 fertilized trout eggs were placed in the upstream end of each hole. A standpipe was placed in the lower end of each excavation about 10 inches away from the eggs, and the hole was filled with gravel to the streambed level. Periodically, determinations were made of gravel permeability and of the apparent velocity and dissolved-oxygen content of the intra-gravel water. A month after calculated hatching times, the bags were removed from the streambed, and the fry contained in them were counted and preserved. The permeability of the spawning gravel fluctuated while embryos were in the gravel. During this period mean gravel permeabilities ranged from 80 to 400 meters per hour; apparent velocities from 5 to almost 110 centimeters per hour; and dissolved-oxygen concentrations from 2.6 to 9.25 milligrams per liter. Embryonic survival percentages ranged from 16 to 62. There was positive correlation between the apparent velocity of ground water and embryonic survivals, and between the dissolved-oxygen levels of the gravel water and survivals. Apparent velocities and dissolved-oxygen concentrations were closely related in the intra-gravel water, and effects of these factors could not be separated.

Dept. Fish and Game Mangt., Oreg. State Col., Corvallis, Oreg.

Hansen, D. F., Bennett, G. W., Webb, R. J., and Lewis, J. M. HOOK-AND-LINE CATCH IN FERTILIZED AND UNFERTILIZED PONDS. Ill. Natl. History Survey B. 27(5): 345-390. 1960.

Six ponds, each of about 1 to 1½ acres, in southern Illinois were used in 1947-52 to measure the effect of pond fertilization on sport fishing. The effect of fertilization was

measured by the sizes of the fish caught, the annual hook-and-line yields, and the catch rates per fisherman-hour.

The ponds were stocked with large-mouth bass 6 to 10 inches long (total length) and bluegills about 1 inch long.

Three of the ponds were treated with chemical fertilizers containing nitrogen, phosphorus, and potassium. The other three ponds (the controls) were not treated.

Creel data were obtained through: (1) Public fishing under a permit system that allowed fishermen relatively free access to four of the ponds; and (2) test fishing by anglers (one each year) employed by the Illinois Natural History Survey to fish each of the six ponds for a 2-hour period each week.

In 1953, after the ponds had been closed to fishing for a year, the fish in all six ponds were killed with rotenone, and a census was made of the fish population.

Growths of filamentous algae, which appeared on the fertilized ponds in some years, were at times a hindrance to fisherman.

Dense stands of water plant, Chara spp., died in the fertilized ponds in the first summer of treatment, while equally dense stands of this plant continued to grow in the control ponds.

Blooms of plankton algae were denser and more prolonged in the fertilized than in the control ponds.

The bass taken from the fertilized ponds averaged smaller but the bluegills larger than those from the control ponds. Bluegills of 8 to 8½ inches were more common from fertilized than from unfertilized ponds.

During the 5 years of fishing for both bass and bluegills the total harvest of bass, by weight, was slightly less from the fertilized ponds than from the controls; the bluegill harvest from the fertilized ponds was 2.7 times that from the controls. The ratio by weight of bass to bluegills was 1:3 in the fertilized ponds, 1:1 in the controls.

One of the fertilized ponds was superior to all others in both bass and bluegill fishing. The three fertilized ponds ranked 1, 5, and 6 in terms of both number and weight of bass harvested per hour; 1, 3, and 4 in terms of number of bluegills harvested per hour; and 1, 2, and 3 in terms of weight of bluegills harvested per hour.

No well-defined year-to-year trend in catch rates for bass was observed during the experiment. The trend in bluegill fishing in both fertilized and control ponds was toward year-to-year improvement in the first 4 years of bluegill fishing.

The two ponds, one fertilized and one control, with the smallest total number of man-hours of fishing had the highest catch rates of harvestable bass. Under equal or nearly equal fishing pressures, bass fishing was in some instances better in the fertilized ponds, in other instances better in the controls; bluegill fishing was consistently better in the fertilized ponds.

In September 1953, the standing crops of bass and bluegills (all sizes) in the three fertilized ponds averaged 292 pounds per acre, in the three controls 238 pounds per acre (ratio 1.2:1). The number of bass 10 inches or longer was approximately the same in fertilized as in control ponds; the number of bluegills 6 inches or longer was 1.3 times as great in fertilized as in unfertilized ponds.

The hook-and-line yields of bass and bluegills in 1952 were equivalent to 20 percent of the 1953 standing crops in the fertilized ponds and 16 percent of the standing crops in the control ponds.

The greater yields of fish from the fertilized ponds were obtained at costs estimated to range from \$0.71 to \$1.18 a pound.

Natural History Survey Div., Urbana, Ill.

Kelley, J. W. SEXUAL MATURITY AND FECUNDITY OF THE LARGEMOUTH BASS (MICROPTERUS SALMOIDES LACEPEDE) IN MAINE. Trans. Amer. Fisheries Soc. 91: 23-28. 1962.

Sexual maturity and fecundity of largemouth bass (Micropterus salmoides) were studied in Maine. Ovaries and ovarian constituents of 46 female bass were described. Atresia, although present, was not prevalent in mature ovaries.

Size-frequency distribution of ova was used to determine ovary maturity. Ovum production per fish of 20 mature bass was determined by a dry-weight method. Individual fecundity ranged from 5,000 to 82,000 ova and varied considerably with the age and size of the fish. Ovum production appeared to decline in fish older than 7 years. Regression equations are given describing relationships between fecundity and age, weight, and length. The correlation between fecundity and age was higher than between fecundity and weight or fecundity and length. Weight was more closely correlated to fecundity than was length. Regression equations are graphically illustrated and their use for prediction purposes was shown.

Maine Dept. Island Fisheries, Augusta, Maine.

Gasaway, C. R. EFFECTS OF CUTTING AQUATIC VEGETATION AND TREATMENT OF THE RESULTING MATS IN PONDS. Trans. Amer. Fisheries Soc. 91: 8-13. 1962.

Several experiments were run on hatchery ponds to determine the effects on pond metabolism of leaving cut but untreated aquatic vegetation and the effects of treating mats of cut vegetation with 2,4-D and ammonium nitrate. Cutting vegetation did not improve environmental conditions until cut plants decayed. Ammonium nitrate appeared to be superior to 2,4-D for inducing decay. When mats were treated with ammonium nitrate, blooms of zooplankton were produced which persisted up to 8 months. No phytoplankton blooms developed after ammonium nitrate treatment, and the higher aquatic vegetation did not grow faster in the treated ponds. Fish kills were not observed near the untreated mats, but dissolved-oxygen conditions there were unfavorable. No fish kills were observed after ammonium nitrate treatment, and growth rates of fish in treated ponds were good.

U. Okla., Norman, Okla.

Katz, M., and Chadwick, G. C. TOXICITY OF ENDRIN TO SOME PACIFIC NORTHWEST FISHES. Trans. Amer. Fisheries Soc. 90: 394-397. 1961.

The toxicity of an endrin formulation to spring chinook and coho salmon, rainbow trout, bluegill, mosquitofish, guppies, and the marine threespine stickleback was determined at 20° C. Coho salmon were the most sensitive, with a 96-hour TL of 0.27 parts per billion endrin; sticklebacks were the most tolerant. A volume effect was demonstrated; bluegills died at lower concentrations of endrin in aquaria with the smallest number of fish. Temperature had a marked influence on toxicity of endrin to bluegills, the toxicity increasing with rise of temperature. Tolerance of endrin by marine threespine sticklebacks was about the same in waters of different salinities. Developing eggs and early larvae of the stickleback are more tolerant than fully developed fish.

Fisheries Res. Inst., Col. Fisheries, U. Wash., Seattle, Wash.

Applegate, V. C., and King, E. L., Jr. COMPARATIVE TOXICITY OF 3-TRIFLUORMETHYL-4-NITROPHENOL (TFM) TO LARVAL LAMPREYS AND ELEVEN SPECIES OF FISHES. Trans. Amer. Fisheries Soc. 91: 342-345. 1962.

The tolerances of larval lampreys, rainbow trout, and 10 species of warmwater fishes to TFM, a selective lamprey larvicide, were determined in three dilution waters of different physical and chemical characteristics. Differential toxic effects of the chemical to larval lampreys and test fishes varied broadly with the species of fish. Smallmouth bass and other centrarchids were most tolerant of the chemical; walleye, yellow perch, bullheads, and white suckers were most susceptible. The toxicity of TFM to both lampreys and fishes diminished as the conductivity and alkalinity of the dilution water increased. The differential action of the chemical was retained in all waters.

U.S. Bur. Com. Fisheries, Ann Arbor, Mich.

Kallman, B. J., Cope, O. B., and Navarre, R. J. DISTRIBUTION AND DETOXICATION OF TOXAPHENE IN CLAYTON LAKE, NEW MEXICO. Trans. Amer. Fisheries Soc. 91: 14-22. 1962.

The fate of toxaphene, applied in three treatments at a total calculated concentration of 0.05 p.p.m. to Clayton Lake, New Mexico, was followed over a 1.5 year period. A detailed description of the chromatographic method of analysis was given. Water concentrations of toxaphene were higher in leeshore samples than in windward samples for 2 weeks after the application; toxaphene levels then appeared to reach a constant value of about 0.001 p.p.m. for at least an additional 250 days. Total body concentrations of toxaphene were determined in trout and bullheads present in the lake during the poisoning and in trout placed in the lake in live-cars subsequently. Trout were more susceptible to toxaphene and accumulated lower body levels than bullheads. Bullheads which showed symptoms of toxaphene poisoning when collected had higher levels than did normal-appearing individuals. No difference in levels was observed in live-car trout collected dead as compared to survivors. Aquatic vegetation accumulated high concentrations of toxaphene; low concentrations were found in some sediment samples. The significance of these findings was discussed.

Bur. Sport Fisheries and Wildlife, U.S. Dept. Int., Denver, Colo.

Upland Wildlife

Lauckhart, J. B. WILDLIFE POPULATION FUNDAMENTALS. 27th North Amer. Wildlife and Natl. Resources Conf. Trans.: 233-241. 1962.

A new approach to animal losses proposes that the old idea that reproduction replaces losses must be abandoned and replaced by the new concept that reproduction causes losses. In any population, the number of animals that die each year must equal the number born. High reproduction causes heavy losses and short life.

This leads to the conclusion that there are no "dangling" populations that do not reach carrying capacity. All populations, with very few exceptions, press carrying capacity every year.

What limits capacity is a most perplexing problem. Social stress as a natural animal control does not seem possible, because there is no way that evolution could have created such a control mechanism. Food was proposed as the most important capacity-limiting factor.

Plants are low in food value, because animals have continually killed out the most nutritious varieties. Exposed plants apparently escape the herbivores by retreating below the animals' threshold of malnutrition.

Recent studies show that grazing and browsing animals can select more nutritious parts from plants that are generally very low in food value. Increased soil fertility can markedly increase the nutritional value of all, or part of a plant.

The maintenance of proper habitat is the key to all wildlife abundance. The destruction of habitat actually kills the wildlife using that habitat.

Wash. State Dept. Game, Olympia, Wash.

Korschgen, L. J. THOSE CURSED WEEDS--WILDLIFE'S FRIENDS. Mo. Conservationist 23(2): 4-6. 1962.

Nature is a dynamic process, and weeds are as much a part of it as are cultivated crops, forests, livestock, wildlife, and people. Weeds by nature are persistent and prolific. Many kinds are of little direct value, while others fill important ecological niches, especially for game animals, songbirds, and other seed-eating species that use the wild plants for food and cover.

Weeds may be classified as: (1) Noxious weeds when they are so undesirable that they are subject to drastic legislation designed to compel their eradication; (2) poisonous plants when they are toxic to livestock or man; (3) nuisance plants when they plague lawn culturists and gardeners by their persistence; and (4) common weeds.

Plants that give a valuable assist to feeding Nature's wild creatures that add so much to the every day living enjoyment of so many people deserve a better name than "weeds". "Wildlife food plants" might be a fitting label to separate them from noxious, poisonous, or nuisance plants so commonly recognized.

Clean farming methods are costly and yield increases from them are generally less than can be caused by weather, over which we have no control.

A study was made to learn quantities of quality foods available to quail and other wildlife in the fall. It related to waste grain from domestic crops, and production from "weeds". Fall foods available to wildlife were sampled in eight kinds of feeding areas; corn, cane, small grain, soybean, pastures, woodlands, sassafras groves, and fallow-waste areas. These types supply the bulk of game bird foods.

Seeds from on and in topsoil samples were counted, weighed, and classified by food quality. Select foods were those known to be preferred by game birds, while non-select seeds included all other kinds.

In 300 samples from northern Missouri, there was an average of 741 potentially viable seeds per square foot of topsoil. They varied from 69 per square foot in woodlands, to 1,913 in small grain fields. Average weight was 139 pounds per acre. All of these were not weed seeds, but more than one-half were. Weed seeds commonly eaten by game birds amounted to 40 pounds per acre. Weed seeds not commonly used amounted to 37 pounds; some of these are used by wildlife under emergency conditions.

Select weed seed foods were most abundant in small grain fields, at 96 lbs. per acre; fallow-waste areas contained 92 lbs. The amount in small grain fields was sufficient to feed

a covey of 10 quail for 290 days for each acre. The addition of wasted domestic grains and lespedeza made small grain acreage capable of supporting a 10 bird covey for 357 days for each acre.

The principal foods of Missouri's game birds are waste grain of farm crops and annual native plants. The proportion in numbers is 7 domestic to 20 native annuals or weeds. Several additional perennial plants also are excellent food producers, but generally are not the targets of widespread weed control.

Among the more important annuals for wildlife were ragweeds, wild beans, crotons, foxtail, grasses, beggar-ticks, and crab grasses.

For both food and cover, weeds may be the most important factor in the natural environment for wildlife. They are provided free and without effort to those who recognize the values. Small grain fields, pastures, and fallow-waste areas are the best producers of wildlife food plants. Simply not mowing these areas in the fall will assure an abundance of food and some cover.

We should fight those cursed weeds that are noxious in field seed production, poisonous to livestock, and a nuisance in the lawn, but at the same time recognize that others have a value--they are wildlife's friends.

Food Habits Biologist.

Murray, R. W. FOOD PLOTS FOR WILD GAME. Fla. Wildlife 16(6): 20-23. 1962.

A food plot is a parcel of land that has been set aside as a planting area for foods preferred by various wild animals and birds. The plots are planted so as to appeal to the tastes and needs of different wild game species.

Game birds and animals require good natural foods and protective cover in order to survive. In some areas, the wild food and cover must be supplemented through the planting of good food plots.

Florida has a wide range of wildlife habitat and wilderness areas. In some cases, the habitat is naturally deficient in good wildlife food and cover. In more instances, the scarcity of food and habitat is the result of changing patterns of land use in the State. In either case, food plots can help compensate.

The food to be planted depends upon the type of wildlife which one wishes to attract. Some of the foods recommended for various game animals and birds are:

- Quail-- Partridge peas, combine peas, bush lespedeza, common lespedeza, Florida beggarweed, browntop millet, corn, and peanuts.
- Turkey-- Pensacola bahiagrass, chufas, corn, peanuts, and browntop millet.
- Dove-- Browntop millet, chufas, corn, and peanuts.
- Deer-- Combine peas, Aeschynomene, crimson clover, white clover, and oats.
- Duck-- Corn, chufas, Japanese millet, and browntop millet.

All food plants should be planted on a well prepared seedbed, fertilized, and managed the same as any agricultural crop.

The following should be planted in 36-inch rows at seeding rates of: Corn, 8 pounds per acre; peanuts, 40 pounds per acre; chufas, 30 pounds per acre; combine peas, 10 pounds per acre; browntop millet, 10 pounds per acre; and bush lespedeza, 8,000 plants per acre. Bush lespedeza is a perennial and requires planting only one time. It should not be planted south of Gainesville. Plantings should be mowed and fertilized in the early spring every second year.

The following should be planted broadcast at seeding rates of: Crimson clover, browntop millet, Japanese millet, and combine peas--20 pounds per acre; Common lespedeza, Pensacola bahia, and partridge peas--15 pounds per acre; Aeschynomene--10 pounds per acre; Beggarweed--8 pounds per acre; White clover--5 pounds per acre (seed must be inoculated); and oats--2 bushels per acre. Common lespedeza should not be planted south of Gainesville. Combine peas and browntop millet should be planted broadcast on new land only.

Fertilizer of the proper analysis should be applied at the following rates: Partridge peas, and peanuts--400 pounds per acre of 2-12-12; bush lespedeza, common lespedeza, beggarweed, Aeschynomene, white clover, and crimson clover--500 pounds per acre of 4-12-12; combine peas--300 pounds per acre of 4-12-12 (in rows) or 500 pounds per acre (broadcast); browntop millet, Japanese millet, and chufas--300 pounds per acre of 8-8-8 (in rows) or 600 pounds per acre (broadcast); Pensacola bahiagrass and oats--600 pounds per acre of 8-8-8; and corn--500 pounds per acre of 4-12-12, and side dress with 150 pounds per acre of ammonium nitrate 30 days after planting.

Biologist, Game Mangt. Div.

Butterfield, R. T. EIGHT STEPS TO MORE SQUIRRELS. W. Va. Conserv. 26(9): 5-8. 1962.

With the ever increasing number of hunters, and a continued decrease of suitable squirrel habitat, some plan must be found to help this popular game animal regain its former abundance. Squirrel management appears to be the only logical way to obtain better hunting.

DEN TREES--It has been found impossible to have abundant squirrels in a woods without a satisfactory number of nesting dens and escape dens. In any timber cutting operation, it is a simple matter to select a series of suitable dens for squirrels or raccoons and reserve them before the cutting starts. These den trees are usually cull trees of little value. A white ring painted on the trees at waist height will save the den tree from damage during the cutting operation. Living den trees will last longer but in some cases it may be satisfactory to girdle or poison such trees, if the tree has a large wolf type form.

ARTIFICIAL DEN BOXES--If natural dens are not available in a wood lot, artificial den boxes can be erected that will serve the same purpose. These boxes can be most any size and of any material such as slabs, hollow logs, nail kegs, and 2-gallon oil cans. The boxes should be spaced throughout the woods in the bigger trees. Construction should allow easy cleaning of the boxes each year.

FOOD TREES--Squirrel food consists of an assortment of nuts, fruits, berries, seeds, buds, and insects. The amount and variety depend upon the season and the availability of the food. Squirrel foods in a woodlot can be increased or improved in many ways. Two or three of the best food producing mast trees per acre should be selected and reserved for wildlife use. Release cutting around these trees will reduce competition for sunlight and water and will improve their production of mast. Fertilization of released trees is important. Special feeding areas such as wild grape thickets should be saved. Wooded areas should be left uncut around a spring drain which is open all winter. The edge of a woods is the section that is most productive for wildlife. The edge of woods can be improved for wildlife by developing a "cut back" by removing the inferior timber and leaving the food producing shrubs to assist in stopping the encroachment of the woods into open fields.

FOOD TREE PLANTING--Where no food trees for squirrels are available or where the quality of food trees need improvement, a long range practice involves the planting of nut and fruit trees. These trees can be spaced in openings in the woods, along borders, or even included in the planting plan during reforestation. With few minor changes most large forest plantations could be altered to benefit wildlife. The planting of chinese chestnut, butternut, pecan, and hickory trees, as well as shrubs of noneysuckle, autumn olive, filbert, and haws, will improve pine plantations for wildlife.

WINTERFEEDING--As an emergency measure when natural foods fail, winterfeeding of wildlife is occasionally suggested to help keep the winter populations of birds and animals in a healthy state so that they are in breeding condition when spring arrives. To keep squirrels in a woodlot, and to keep them healthy during years of mast failure, the distribution of ear corn will help.

PREDATION--Predation of squirrels is of questionable concern. Owls, hawks, foxes, blacksnakes, and other predators take a small portion of the normal population.

NORMAL HUNTING--Normal hunting pressure by the squirrel hunters merely skim the cream from the squirrel population and does not kill every squirrel in a woodlot. Saving squirrels for next year's population is just like saving money for the rainy day that is sure to come.

District Wildlife Manager, Dept. Natl. Resources, Buckhannon, W. Va.

Garrison, R. C. FACTS ABOUT FLORIDA RABBITS. Fla. Wildlife 16(4): 20-23. 1962.

There are three species of rabbits in Florida; the eastern cottontail (Silvilagus floridanus); the marsh rabbit (Sylvilagus palustris); and the swamp rabbit (Sylvilagus aquaticus).

The cottontail is grayish-brown in color and carries the distinctive white "powder puff" tail from which it takes its name. Female cottontails often breed after 9 months of age and may produce three litter of young in 1 year. After a gestation period of about 28 days, from four to six young are born. The young are weaned in less than 3 weeks.

The marsh rabbit is covered with hair that is coarser and darker brown in color than the cottontail. It has a small inconspicuous tail that is a dingy white on the underside. This rabbit will often walk rather than hop. The marsh rabbit is generally found in marsh or swamp lands. It is an accomplished swimmer and takes to the water readily.

The swamp rabbit is restricted largely to the northern portions of Florida. It is quite similar to the marsh rabbit both in appearance and habits. The swamp rabbit is the largest of the rabbits in Florida with hair even coarser than that of the marsh rabbit. The swamp rabbit swims well and, as the marsh rabbit, it will often walk rather than hop.

The cottontail is normally found in uplands with open grassy areas and nearby dense thickets of brush or palmettos. The marsh rabbit and swamp rabbit prefer wetter situations and more cover. The proximity of cover is a basic requirement of all the rabbits of Florida.

Tularemia is a disease that is sometimes carried by rabbits and may be transmitted to man; however, this same disease is also carried by many other species of animals including the deer, fox, cat, dog, squirrel, skunk, quail, hog, sheep, and opossum. Some persons are reluctant to hunt or eat rabbits because of the publicity that has been given the disease. The occurrence in Florida is low, and if a hunter will take a few simple precautions, there is no reason to fear the disease.

Biologist, Game Mangt. Div.

Most of the year the cottontail's home is a "form" concealed in a grassy field or fence row. Young are usually raised in a well-drained area in a variety of cover types, including grass in pastures, fence rows, weedy fields, and other places. Rabbits need well-distributed cover, a safe place to rear young, and an ample year-round food supply. Surface water is not important, because rabbits get their water needs from the succulent plants. Rabbits generally remain near where they were born.

Game biologists suggest that modifying habitat to provide "all the comforts of home" is the best way to increase rabbits. If the habitat is poor, rabbits will be few. If the habitat disappears, game will vanish also. Cutting down the necessary size of the home range by providing more of the rabbit's needs will increase rabbits. Increase in food will do this, allowing more animals to get their food needs on smaller units of land.

The carrying capacity of a tract of land varies from month to month, declining as the hunting season progresses and the annual vegetation breaks down. Rabbits are then squeezed into a late winter "bottleneck" in the "hard core" cover that remains.

What is good rabbit cover? The most important factor in determining a good rabbit population is the quality and interspersed of the cover and available food. A "hard core" cover unit can be of several types, but any of its types have to stand up through the winter to maintain a population through severe weather. The following are examples of "hard core" rabbit cover: (1) Woody cover in hedgerows, weedy fence rows, thickets of blackberry briars. (2) *Sericea lespedeza*, a legume, produces excellent cover in a short time. *Sericea* is most valuable when planted in strips from 10 to 20 feet wide, alongside permanent woody cover such as an overgrown woodlot, brushy gully, or an uncleared fencerow. (3) Multiflora rose, when planted as a fence, with a border of *sericea* or mixed grasses, becomes the "home base" for rabbits. Clump plantings of multiflora rose also are excellent. And (4) rabbits will enter a brushpile the night after it is made. It is best to pile the brush over large rocks, logs, old culvert pipe, or discarded farm equipment. This keeps the trash off the ground near the middle and allows more freedom of movement for the rabbits. The pile should at least be 15 feet in diameter and 5 feet high. It is important to place the brushpiles right in or very close to other permanent cover, such as briars, fencerows, woods, or un-pastured grass. A brushpile out in a closely grazed pasture is not as valuable as the same brushpile would be if placed adjacent to or into a draw, where there is some ungrazed or unmowed cover left for a travel lane to food.

Game Biologist.

Julander, O. RANGE MANAGEMENT IN RELATION TO MULE DEER HABITAT AND HERD PRODUCTIVITY IN UTAH. J. Range Mangt. 15: 278-281. 1962.

Heavy grazing by livestock in early days (1890-1920) caused profound changes in mule deer range in Utah that have reduced herd productivity.

Overgrazing by livestock and reduced wildfire resulted in a increase in woody species on deer winter range. This made possible the buildup of excessive deer numbers--probably far greater than could have been possible on virgin range. However, over-grazed livestock range often does not provide sufficient herbaceous forage for deer during the critical early spring period.

Intermediate range overgrazed by livestock may provide adequate browse for deer use in the fall, but may be deficient in new forb growth required by does in late pregnancy and during fawning season.

Depleted summer ranges may provide survival rations for over-populations of deer, but do not provide nutrients sufficient for high herd productivity. Adequate yearlong forage is essential for maximum herd productivity. °

Overpopulations of deer on range already overgrazed by livestock have drastically deteriorated both vegetation and soil on deer winter-stress areas, and have added to range problems on intermediate and summer range.

Because deer have destroyed most of their emergency forage on many areas, maximum winter populations are now limited largely by the amount of current growth of forage.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Tester, J. R., and Marshall, W. H. MINNESOTA PRAIRIE MANAGEMENT TECHNIQUES AND THEIR WILDLIFE IMPLICATIONS. 27th North Amer. Wildlife and Natl. Resources Conf. Trans.: 267-286. 1962.

A field study to determine the effects of four treatments--spring burning, fall burning, grazing, and mowing--on the flora and fauna of native tall grass prairie was carried on at the Waubun Prairie Research Area in Mahnomen County, Minnesota, from 1957 to 1961. A total of 70 acres of relatively undisturbed native prairie was selected within the 640-acre tract. On five 10-acre plots mowing, grazing, or burning was carried out. Two plots were left untreated and used as controls.

The effects of the four treatments on litter, upland grasses and forbs, upland woody plants, and shoreline vegetation are discussed. The invasion of the prairie by aspen and willow and the effects of burning, grazing, and mowing on this invasion are considered in detail.

Based on these data, as well as published information on the ecology of both prairie chickens and breeding waterfowl, suggestions for management are made. A 4-year rotation of spring burn, no treatment, graze, and no treatment was recommended. Such a schedule should maintain the original status of prairie habitats in this ecotone between forest and grasslands.

U. Minn., St. Paul, Minn.

The Conservationist. A SYMPOSIUM--INSECTICIDES AND WEED-KILLERS. N.Y. Conservationist. 17(3): 6-16, 40-41. 1962.

The Conservationist presented a symposium on insecticides and weed-killers.

Five highly - qualified scientists were invited to give their ideas on selected aspects of the problem described by Rachel Carson in her recent book "Silent Spring."

The following is author, title, and address of author for each article presented:

1. Wilm., H. G. A STATEMENT. N.Y. State Comn. Conserv.
2. Gavagan, J. E. THE SILENT SPRING OF RACHEL CARSON. (No address given.)
3. Randolph, T. G., and Spetz, M. HUMAN ECOLOGY AND SUSCEPTIBILITY TO THE CHEMICAL ENVIRONMENT. Chicago, Ill.
4. Brown, A. W. A. EFFECTS OF INSECTICIDES ON WILDLIFE. U. Western Ontario, London, Ontario, Canada.
5. Stegeman, L. C. A GLIMPSE OF THE ANIMAL LIFE OF THE TOPSOIL. State U., Col. Forestry, Syracuse, N.Y.

Bolle, A. W., and Taber, R. D. ECONOMIC ASPECTS OF WILDLIFE ABUNDANCE ON PRIVATE LANDS. 27th North Amer. Wildlife and Natl. Resources Conf. Trans.: 255-267. 1962.

A distinction is made between wildlife diversity and wildlife abundance, the former meaning the number of different species and the latter the number of different individuals. Wildlife diversity cannot be considered in the usual economic terms, because a species is irreplaceable. Certain aspects of wildlife abundance can be treated in economic terms. Consideration is given to the economic value to the landowner of the wildlife on his land. A current survey indicates that the value of good waterfowl habitat is in the \$10 to \$100 per acre per year range. Most of it is leased. Value of private forest and range land is in the \$0.10 to \$1 per acre per year range. Leasing is most common where public lands of the same type are few.

There is little leasing of farm land. Because there is no cash income for wildlife to the farmer, wildlife does not have a positive economic value. Consequently, in the business operation of the farm, wildlife is not considered. The result is loss of farm wildlife habitat and decline in farm wildlife abundance.

Vigorous efforts to provide cash income to the farmer should be made, as a way of enhancing wildlife habitat and increasing wildlife abundance.

Mont. State U., Missoula, Mont.

Longhurst, W. M., Jones, M. B., Parks, R. R., Neubauer, L. W., and Cummings, M. W. FENCES FOR CONTROLLING DEER DAMAGE. Calif. Agr. Expt. Sta. C. 514, 19 pp. 1962.

The most practical method of minimizing or controlling deer damage to high-value crops in California has been through the use of well constructed fences. Although initial costs are high and continuing maintenance is necessary, fencing is economically justified for the protection of certain crops, orchards, vineyards, irrigated pastures, and new forest plantings.

Two types of fence have proven most successful in California: The upright fence, and the slanting, or overhanging, fence. Electric fences are not generally satisfactory in the state.

Important factors to consider when planning and building fences are given. Illustrations of construction details are included.

Agr. Pub., Room 207 U. Hall, 2200 U. Ave., Berkeley 4, Calif.

Agrons, B. Z. IN CALIFORNIA'S REDWOOD REGION, DEER DO DAMAGE TO PLANTED DOUGLAS FIRS. Western Conserv. J. 19(2): 50-53. 1962.

The problems of intensive management of forest lands have been complicated by the resident wildlife populations. Animals bring various pressures to bear on the intricate forest relationships that we need to understand and to bring under control.

The most difficult problems concern those associated with big game animals which are complicated by social and political aspects, in addition to the purely biological complexities. Control efforts against problems caused by small animals and birds do not evoke the same passionate response, but are sometimes very difficult to control when large land areas are involved.

In some sections of the country, mice, rabbits, and squirrels can raise havoc with regenerating timber stands. Pine region foresters have sought successful methods for reducing porcupine damage for many years. Seed destroying rodents are a factor in forest regeneration and have been studied from many angles, and a degree of control is possible under particular situations. In Humboldt County, California, an epic struggle against bear depredation has been waged for about 10 years, with a significant measure of success. More recently seedling damage caused by the browsing of deer and elk has caused alarm.

Wildlife populations are biological entities. They follow the same rules of life that govern all living organisms. Above all, big game animals are subject to scientific management for maximum production and harvest.

Five years ago, Rockport Redwood Company embarked upon a program of reforestation of its understocked cutover lands. It conducted an experimental program by staking 1,800 planted trees in various areas and situations on its property. During the survival studies, the company noticed that a great many planted trees had been damaged by deer browsing.

It was estimated that the growth of the company's young trees were retarded for a period of 20 years. This means that such stands will have to be carried for 70 years in order to get normal 50 year old trees.

The author concluded that: (1) Logging practices in recent years have created a fine habitat for big game animals, but present game management regulations have prevented their proper utilization. In some areas, wildlife populations have exploded to the full carrying capacity of the range causing depredation to reproducing conifers. (2) Wildlife populations can be managed like any other biological entity but there is much to learn about forest-wildlife relationships. (3) On a region-wide basis, it is probable that deer depredation and destructive taxation are the two greatest enemies to economic forest management. (4) Big game management problems are complicated by many divergent interests which must be reconciled or subjugated if the animals are to be properly managed in harmony with other resource values. And (5) sport hunting under a system of scientific game management probably offers the best means of animal damage control. We should intensify our efforts to seek out other means of control but must still press forward to gain public support for legislation that will permit compatible game and timber management.

Rockport Redwood Co., Westport, Calif.

Wetland Wildlife

Hopkins, R. C. DRAWDOWN FOR DUCKS. *Wis. Conserv. B.* 27(4): 18-19. 1962.

Draw down the water level in the spring and the waterfowl pond, flowage, or marsh will be much more attractive to ducks in the autumn because of the food plants which will volunteer in the drained area. The area can then be reflooded in late August or early September.

The drawdown management practice is being used all over Wisconsin on many State-owned areas and on a number of private waterfowl areas. By lowering and raising water levels, plant succession can be controlled to bring about production of the kinds of foods waterfowl and many other wildlife species like most.

Time the drawdown for food production carefully, the ducks should be largely finished with breeding before the area is drained. Mallards, pintails, wood ducks, and black ducks reach the peak of breeding activity in central and southern Wisconsin about April 20, with earliest broods leaving the nest in mid-May. Once nesting is well under way, a drop in the water level will be of little consequence to the duck.

It is desirable to have an area that is going to be drawn down completely submerged in water for at least one growing season preceding the year of the drawdown. When the water is drawn off, it will result in the exposure of mud and sand flats where aquatic plants and marsh plants that need standing water are growing. The water-living plants will die or do poorly and the area will immediately be invaded by primitive dry land species of the kinds which we are now trying to culture.

By this technique, the game manager hopes to produce two main groups of plants, the smartweeds and the millets. In southern and central Wisconsin in areas which are not too acid, up to five different species of smartweeds will be present and seeds from most of them will germinate and grow well even after having lain dormant in water or marsh for years or even several decades.

The culture of millet through this technique is much less certain and seeding is recommended to insure its successful production. Several Wisconsin game managers believe that jap millet is the best species to use.

The most economical method of sowing millet seed over large areas is by airplane immediately after the area has been drained.

The drawdown management practice and reflooding alone do an effective job without supplementary crops. But jap millet, buckwheat, or some other grain is the frosting on the cake that will tend to insure that by drawing down water you will also draw ducks. That is why supplementary crops are used on state-owned lands.

District Game Manager, Wautoma, Wis.

Ruskanen, A. FOR MALLARDS, A HELPING HAND. Wyo. Wildlife 26(8): 28-32. 1962.

A problem of most serious concern to conservationists and wildlife managers today is the country's dwindling waterfowl supply.

The Wyoming Game and Fish Department has worked for years to insure huntable populations of ducks and geese for the future. The Department's most notable efforts have taken place at Ocean Lake in Fremont County. Artificial islands and nesting platforms built at the lake have been highly successful.

The theory behind the artificial island is simple. Huge loads of sand and gravel are dumped on the ice over shallow areas of the lake during winter. When the ice melts, the material sinks to the bottom of the lake, building up until it projects above the surface of the water, forming an island. Bales of straw are placed on the islands for nesting material and a man-made nesting site is available for Canadian honkers.

The nesting platforms are also simple in design. They consist of four large timbers embedded in the ground with a wooden nesting box built on top of them about 10 feet from the ground. Straw placed in the boxes is used as nesting material by the geese.

Canada goose production at Ocean Lake increased 31 percent in 1961. Forty-five nests containing 234 eggs were counted at the lake last year while 38 nests with 194 eggs were counted in 1960.

Eighty-six percent of all goose eggs at the lake were successfully hatched in 1961. Since 1955, the number of goose nests at Ocean Lake have increased from 17 to 45 and the number of eggs from 78 to 234.

Robert Brown of Wadsworth, Ill., recently produced an artificial nesting box that might be the key to increasing ducks across the country. His boxes have produced 100 ducklings in ponds which produced few, if any, broods of ducks previously. The box is made from a piece of plywood, 1/8 inch thick, about 2 feet long and 44 inches wide. The plywood is steamed until it becomes pliable, then bent into a barrel shape and bolted at the bottom seam so it

will hold its shape. A steel rod or rope is inserted through holes drilled through the nesting box. A washer and cotter pin are placed on the steel rod against the bottom of the box. This prevents it from sliding down the rod into the water. Nesting material is placed in the box, the rod driven into the mud of a shallow pond bottom, and the nesting box is ready for a family of mallards. Materials for the box cost less than two dollars. Time spent in assembling it is less than an hour, after the steaming process to make the plywood pliable is completed.

Artificial nesting boxes aren't a new innovation. They've been used successfully by wood ducks for years. This is the first box, however, which has been used successfully by puddler ducks such as the mallard.

Brown's nesting box has proved completely predator-proof. It turns freely in the wind and ducks do not have to touch the water before entering the box. Ducks seem to prefer it to natural nesting sites along pond shorelines, even when they are available.

No address given.

NEELY, W. W. SALINE SOILS AND BRACKISH WATERS IN MANAGEMENT OF WILDLIFE, FISH, AND SHRIMP. 27th North Amer. Wildlife and Natl. Resources Conf. Trans.: 321-334. 1962.

Methods have been developed for the management of brackish water impoundments for commercial shrimp production, for producing crops of fish for commercial harvest or sport fishing, and to grow duck foods. Methods have also been developed for making duck fields, snipe fields, and wild goose pastures on saline soils. Management methods are described for various ranges of salinity.

Cat-clays are a potential hazard for wildlife management in coastal marshes. By means of repeated changes of water, it is possible to reclaim some areas where cat-clays have developed.

An inexpensive and convenient field method of measuring salinity is with a Vogel Uri-nometer. Other methods are by electrical conductivity and titration. A nomograph is presented for easy conversion of the various ways of expressing salinity. A listing by salinity tolerance is made of selected agricultural crops, native duck food plants, and other native plants.

SCS, USDA, Walterboro, S.C.

Salyer, J. W. EFFECTS OF DROUGHT AND LAND USE ON PRAIRIE NESTING DUCKS. 27th North Amer. Wildlife and Natl. Resources Conf. Trans.: 69-79. 1962.

Lack of precipitation (both rain and snow) caused poor water conditions for waterfowl production in 1959 and 1961. Much better conditions existed in 1960 when good rains and snow the preceding fall and winter filled the potholes. Waterfowl production was evaluated in relation to the effects of drought and grazing intensity.

Breeding pair populations tended to fluctuate with the number of available water areas, but showed no distinct relationship with grazing intensity. The number of suitable breeding territories was reduced during drought and the population declined. There was no decline in

the nesting effort nor in the clutch size among pairs finding territories. The success of their reproductive efforts was very low because of increased predation and embryo mortality in the drought year. The size and number of the broods were also much lower, probably due to the greater distance from nest to water.

Diving duck populations responded dramatically, both in numbers and reproductive success, to the changing water levels.

Mo. Coop. Wildlife Res. Unit, Columbia, Mo.

MacInnes, C. D. NESTING OF SMALL CANADA GEESE NEAR ESKIMO POINT, NORTH-WEST TERRITORIES. J. Wildlife Mangt. 26: 247-256. 1962.

Small Canada geese of the hutchinsii-parvipes group nested on sphagnum-covered islets in the flat coastal sedge marshes near the McConnell River. A total of 119 nests were studied, in an average density of 6.5 per square mile. A large colony of blue geese in the same area contained as many as 1,000 nests per square mile. The nesting period approached the minimum possible (30 days). This is the shortest recorded for any of the subspecies of Canada goose. Normal clutch size was five. Incubation required 24 or 25 days. Parasitic jaegers and herring gulls caused egg losses of 20 percent in 1959 and less than 5 percent in 1960. The difference was due chiefly to reduced jaeger predation in 1960, apparently the result of high lemming population. Production was 64 percent of maximum in 1959, and 81 percent in 1960, comparing favorably with that reported for other subspecies in more southern breeding areas.

Dept. Conserv., Cornell U., Ithaca, N.Y.

Junca, H. A., Epps, E. A., and Glasgow, L. L. A QUANTITATIVE STUDY OF THE NUTRIENT CONTENT OF FOOD REMOVED FROM THE CROPS OF WILD MALLARDS IN LOUISIANA. 27th North Amer. Wildlife and Natl. Resources Conf. Trans: 114-121. 1962.

During the 1961 hunting season 215 crops containing food were removed from wild mallards in southwest Louisiana. Grass seeds made up the bulk of the food eaten. The most important grasses were millets, paspalums, fall panicum, giant foxtail, bag scale grass, and domestic rice. Smartweed was important at two collection areas. Animal matter and grit were present in small quantities.

Proximate analyses of crop contents revealed that the foods had the following nutrient percentages: protein 14.8, ether extract 2.9, fiber 14.7, NFE 52.4, ash 14.5, calcium 1.19, and phosphorus 0.498. When compared with a diet for breeder ducks recommended by Scott and Holm (1961), crude protein was deficient by 22 percent, fat by 52 percent, calcium by 56 percent, and phosphorus by 37 percent.

Since approximately 81 percent of the ducks were in good condition and 2 percent in poor condition, it was concluded that wild mallards thrive on a diet having smaller quantities of nutrients than do wild mallards in captivity.

La. State U., Baton Rouge, La.

Jemison, E. S., and Chabreck, R. H. THE AVAILABILITY OF WATERFOWL FOODS IN COASTAL MARSH IMPOUNDMENTS IN LOUISIANA. 27th North Amer. Wildlife and Natl. Resources Conf. Trans.: 288-300. 1962.

The amounts of food available for wintering waterfowl in two impoundments, Lakes 3 and 14 on Rockefeller Refuge in southwestern Louisiana, were studied.

A total of 120 marsh floor samples and 18 vegetative samples were collected from the two impoundments and the contents analyzed.

Seeds from 22 species comprising 11 plant families occurred in the marsh floor samples. Based on pounds per acre and frequency of occurrence in samples, the seeds present in greatest amounts were: sawgrass, bullwhip, cyperus, millet, dodder, and widgeongrass.

Bullwhip and sawgrass seeds occurred in larger amounts in both impoundments than did seeds of the other major species. Bullwhip seeds amounted to 410.4 pounds per acre in Lake 3 and 65.5 pounds per acre in Lake 14. Sawgrass seeds amounted to 231.6 pounds per acre in Lake 3 and 335.9 pounds in Lake 14. Since neither of these plants has occurred in dense stands in either area for several years, the seeds had probably remained dormant in the soil. Seeds of these species were found in great amounts as deep as 8 inches in the soil.

Although samples were collected in a dense stand of widgeongrass in Lake 3 and in a dense stand of millet in Lake 14, the amount of seeds of these species were surprisingly low. Widgeongrass seeds averaged 4.6 pounds per acre in Lake 3, while millet seeds averaged 15.5 pounds per acre in Lake 14.

There was little relationship between the vegetative stand composition on the areas at the time of sampling and the seeds that were available in the soil.

A general decline was noted throughout the wintering season in the seeds of most species; but several exceptions were noted. Since both impoundments supported tremendous numbers of ducks throughout the winter, it was assumed that the seeds were eaten by ducks. Although approximately 100 pounds of seeds per acre were removed, this amounted to less than 20 percent of the seeds available.

Over 70 percent of the seeds of major species occurred within the top 4 inches of the soil; however, all species of major importance were found as deep as 10 inches.

Results of vegetative samples showed a considerable decrease in wideongrass from October to March. This was attributed primarily to waterfowl usage, since many birds were observed feeding in the area and the discarded remains of this plant seen uprooted and floating on the water.

La. State U., Baton Rouge, La.

Nicholson, H. P., Webb, H. J., Lauer, G. J., O'Brien, R. E., Grzenda, A. R., Shanklin, D. W., Lauer, G. L., and Nicholson, H. P. INSECTICIDE CONTAMINATION IN A FARM POND: I. ORIGIN AND DURATION; AND II. BIOLOGICAL EFFECTS. Trans. Amer. Fisheries Soc. 91: 213-222. 1962.

The effects on water quality and aquatic life of parathion and other insecticides used in peach culture were studied. The magnitude, origin, and duration of insecticide pollution and the biological effects are given.

The study pond was located in a 40-acre watershed where peaches were the principal crop. Parathion and minor amounts of chlorinated hydrocarbon insecticides were used for pest control. In 1960 parathion was used in the watershed from April 11 to August 1. Parathion residue (1.7 p.p.m.) was present in a surface soil sample collected before insecticide use in 1960. This indicates parathion persisted in the soil for at least 9 months. Surface soil samples taken during and after parathion use in 1960 contained from 0.23 to

1.39 p.p.m. parathion. In March, prior to insecticide use in 1960, 1.90 p.p.m. parathion were recovered from pond bottom mud. Lesser concentration of parathion (0.02 p.p.b.) were obtained from two water samples at this time. Indications are that most of the parathion present immediately before use in 1960 entered the pond adsorbed on soil during a period of accelerated erosion in March 1960. The parathion content of the pond water generally increased as the spraying season progressed. Parathion (0.01 p.p.b.) was present in water collected 4 months after the last application of insecticide in 1960. The parathion content of pond mud decreased during the course of the spraying season. This was believed to be due to decomposition of existing residues and a reduction in quantity of soil deposited in the pond.

The fish, zooplankton, aquatic insect, and Oligochaeta populations appeared to be unaffected by parathion residues in pond water and mud. However, there was a significant reduction in immature aquatic insect numbers associated with insecticide use. The data indicate this was caused indirectly by mortality in the adult populations resulting from exposure to parathion residues in the watershed. Zooplankton were not utilized as food by bluegills when immature chironomids were relatively abundant. However, when the insect standing crop became severely reduced the fish fed almost entirely on planktonic Crustacea.

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SUPPLEMENT

Problems Indirectly Affecting the Application of Soil and Water Conservation Practices

Jordan, L. S., and Day, B. E. EFFECTS OF SOIL PROPERTIES ON EPTC PHYTOTOXICITY. Weeds. 10: 212-215. 1962.

Oats, sesbania (*Sesbania macrocarpa* Muhl.), and purple nutsedge (*Cyperus rotundus* L.) were grown as test plants in nine different soil types treated with 0, 0.5, 1, 2, 4, 8, and 16 p.p.m. of EPTC. Toxicity of EPTC was negatively correlated with the organic matter of the soil. A positive correlation was found between the sand and silt content of the soil and EPTC toxicity to oats and nutsedge. Toxicity of EPTC was not correlated with soil pH, cation exchange capacity, clay content, general reaction, or parent material. EPTC induced a dormancy of nutsedge tubers, of which the length was inversely related to the organic content of the soil.

U. Calif., Riverside, Calif.

Fleming, W. E. THE JAPANESE BEETLE IN THE UNITED STATES. U.S. Dept. Agr., Agr. Res. Serv. Agr. Hbk. 236, 30 pp. 1962.

The Japanese beetle (*Popillia japonica* Newm.) was first found in the United States in 1916 in a nursery near Riverton, N.J. It was previously known to occur in the main islands of Japan.

Only about a dozen beetles were found in 1916. From this small beginning the beetle multiplied rapidly and spread until by 1962 it had invaded over 100,000 square miles in the

eastern part of the United States, and it had become established in several isolated areas beyond this region of natural distribution. Soon after its establishment in this country, the beetle demonstrated that it was a pest of major importance.

The range of the Japanese beetle widens each year. The appearance, life history, habits, economic importance, and the native and imported natural enemies of the Japanese beetle are discussed.

Protecting plants from the ravages of the beetle is now much easier than in the early days of its invasion into the Eastern States. The insecticides then available were only partially effective in protecting plants from attack by the adult beetle; little was known about the control of grubs in the soil. Now, with light populations of beetles in the older infested areas and potent insecticides available, it is relatively easy to prevent them from doing extensive damage. Foliage and fruit can be protected by timely applications of sprays containing DDT, methoxychlor, Sevin, malathion, or parathion. Lawns and golf courses can be protected for 5 or more years by a single application of aldrin, heptachlor, dieldrin, chlordane, toxaphene, or DDT.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781.

Sharratt, W. J., Peterson, A. E., and Calbert, H. E. EFFECT OF WHEY ON SOIL AND PLANT GROWTH. *Agron. J.* 54: 359-361. 1962.

The effects of applying various increments of whey to Miami sil on the soil and corn growth were studied. The applications were made over a 3-week period before corn planting. Analyses of the whey showed that 1 acre-inch contains 330 pounds of nitrogen, 110 pounds of phosphorous, and 400 pounds of potassium, which would cost \$100 in the form of commercial fertilizers. The phosphorous, potassium, and sodium contents of the soil were increased 3- to 5-fold by an 8- to 12-acre-inch application, and doubled by a 2- or 4-inch application. Conductometric determinations indicate that at the heavy rates of application sufficient salts may accumulate to restrict plant growth during the first season after application. However, this is not a problem the second season. All rates of whey application were effective in increasing corn yields the first and second season after application, the lighter rates being most effective the first season and the heavier the second season. Nitrate determinations in soil receiving whey indicated that the organic nitrogen in whey is readily converted to nitrates during the first and second seasons after application. In general it may be concluded that whey had a beneficial effect on soil aggregation.

Whey can improve soil structure and provide plant nutrients, but it appears that its feeding to livestock would accomplish more complete utilization of whey solids. At periods of maximum production, when adequate disposal means are unavailable, the application of whey to soil can very appreciably benefit the following corn crops and the soil.

TVA, Wilson Dam, Ala.

Radioactive Fallout

Nishita, H., Taylor, P., Alexander, G. V., and Larson, K. H. INFLUENCE OF STABLE Cs137 AND K42 IN SOILS AND CLAY MINERALS. *Soil Sci.* 94: 187-197. 1962.

Experiments were conducted to study the influence of stable Cs and K on the reactions of tracer quantities of Cs-137 and K-42 in soils and clay minerals, using an equilibrium batch method.

Tracer quantities of both Cs-137 and K-42 were strongly sorbed in soils and clay minerals. Cesium was more strongly sorbed than K. Since the initial trace quantities of carrier-free Cs-137 were very strongly sorbed, the sequence of the addition of the tracer radioisotope in relation to the addition of stable Cs and K determined the level at which equilibrium was attained. The absolute amount of Cs and K sorption depended on the kind of clay mineral and soil. Cesium sorption relative to K was greater in Ca-clay than in H-Al-clay.

The concentration of the stable Cs and K present was also an important factor. When the tracer Cs-137 was diluted to a negligible fraction of the total Cs in solution, only a negligible fraction of Cs-137 was sorbed. In equimolar mixtures of Cs and K, the sorption of Cs relative to K decreased as the ionic concentration increased. As a corollary to this effect, under conditions of low ionic concentration, stable Cs was much more effective than K in releasing Cs-137 from soils. In high concentrations K was, in certain soils, as effective as stable Cs.

U. Calif., Los Angeles, Calif.

Nishita, H., Dixon, D., and Larson, K. H. ACCUMULATION OF Cs AND K AND GROWTH OF BEAN PLANTS IN NUTRIENT SOLUTION AND SOIL. *Plant and Soil* 17: 221-242. 1962.

Bean plants were grown to maturity in nutrient solutions and soils to study the influence of Cs and K on the growth and the uptake of K and radioactive and stable Cs.

The application of K to Cs-147-treated soils relatively high in exchangeable K had only slight effect on the plant uptake of Cs-147. Increasing additions of K to Cs-147-treated nutrient solution decreased the uptake of Cs-147. In both soils and nutrient solutions, the applications of K increased the K-uptake by plants. It may be concluded that when K is readily available to plants, Cs-147-uptake will be relatively low, but when K is relatively unavailable in the soils, Cs-147-uptake will be high and can be reduced by the application of K.

Small applications of stable Cs to contaminated soils and nutrient solutions caused a greatly increased Cs-147-uptake by plants, presumably a carrier effect. Large applications of Cs reduced the uptake of Cs-147 because of isotopic dilution. Up to a certain threshold level, the plant uptake of K increased with that of stable Cs and appeared to be partly non-competitive with Cs.

Bean plants discriminated against Cs. The discrimination between Cs and K varied with K- and Cs-concentration in the nutrient media.

Cesium was toxic to bean plants. Cesium toxicity symptoms were different from K-deficiency symptoms. The toxic effect of Cs was alleviated to some extent by increasing the application of K. In the soils studied, reduction in plant yields occurred when the application of Cs was greater than 8 percent of the soil cation-exchange capacity.

U. Calif., Los Angeles, Calif.

Essington, E., Nishita, H., and Wallace, A. INFLUENCE OF CHELATES ON AVAILABILITY OF FISSION PRODUCTS TO PLANTS GROWN IN A CONTAMINATED SOIL. *Soil Sci.* 94: 96-105. 1962.

The influence of the following chelates: (EDTA, DTPA, CDTA, DHEEDDA, NTA, EDDHA, HEEDTA, and Ra156) on the uptake of Y-91, Sr-90, Zn-65, and Cs-137 by bean plants grown in a contaminated calcareous soil was investigated. The plant uptake of Sr-90

and Cs-137 was unaltered by chelate applications to the contaminated soil. Most of the chelates increased plant uptake of Y-91 and Zn-65. DTPA and H-CDTA had the greatest effect in increasing the uptake of Y-91 and Zn-65, EDDHA and Ra 156 had no effect on Y-91 uptake. Na-EDDHA decreased Zn-65 uptake. Leaf to root ratios for Y-91 and Zn-65 indicated that chelates increased the translocation of Y-91 and Zn-65 to the leaves from the roots. Part of the ineffectiveness of EDDHA and Ra 156 appeared to be their low chelation power at the pH level of the soil, which was 7.8.

U. Calif. Medical Cent., Los Angeles, Calif.

Reichert, S. O. RADIONUCLIDES IN GROUNDWATER AT THE SAVANNAH RIVER PLANT WASTE DISPOSAL FACILITIES. J. Geophysical Res. 67: 4363-4374. 1962.

At the Savannah River Plant, disposal of radioactivity to the ground has been limited to the burial of solid waste and the discharge of very-low-level waste to open seepage basins. Although solid wastes have been subjected to leaching by annual rainfall of 45 to 50 inches since 1953, no radionuclides have been detected in groundwater from this source. Seepage basin retention of radionuclides has been less satisfactory. All of the radionuclides released to the seepage basins, except plutonium, have been detected in the surrounding groundwater. Fission-product tritium, present in water, is not adsorbed and thus serves as a useful groundwater tracer. Strontium-90 is poorly adsorbed on local soil (under the acidic conditions usually present in seepage basins) and is detectable in sand layers, at concentrations, less than the Radioactivity Concentration Guide, as far as 500 feet from the basins. The radionuclides of cerium, cesium, ruthenium, zirconium, and niobium do not migrate as far as those of strontium. The path of radionuclide migration from the seepage basins [excavated in the Hawthorn formation (Miocene)] is determined by the geology and hydrology of each area. Most of the migration of radionuclides has been through sandy strata or sand-filled clastic dikes. Wherever the soils do not contain these imperfections, migration has been slow.

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